TECHNICAL REPORT
NATICK/TR-83/037

AN IN-PORT FEEDING SYSTEM FOR SHIPBOARD PERSONNEL VOLUME 3 A PERSONNEL, EQUIPMENT, AND FACILITY EVALUATION OF THE ENLISTED DINING FACILITIES AT NAS NORTH ISLAND AND NAVSTA SAN DIEGO

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MAY 1981

UNITED STATES ARMY NATICK
RESEARCH & DEVELOPMENT LABORATORIES
NATICK, MASSACHUSETTS 01760

OPERATIONS RESEARCH AND SYSTEMS ANALYSIS OFFICE

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NATICK/TR–83/037	2. GOVT ACCESSION NO. AD-A137536	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) AN IN–PORT FEEDING SYSTEM FOR SHIPBOARD PERSONNEL – VOLUME 3 A Personnel, Equipment and Facility Evaluation of the Enlisted Dining Facilities at NAS North Island and NAVSTA San Diego		5. TYPE OF REPORT & PERIOD COVERED Technical Final Report 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Frank D. Borsenik		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS University of Nevada, Las Vegas College of Hotel Administration Las Vegas, NV 89154		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 6.2 1L162724AH99A Task AA
11. CONTROLLING OFFICE NAME AND ADDRESS US Army Natick Research and Development Laboratories Natick, MA 01760		12. REPORT DATE May 1981 13. NUMBER OF PAGES 71
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Military Service Requirement No. USN 9–2 In-Port Feeding Systems for Shipboard Personnel

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DINING HALLS
DINING FACILITIES
FEEDING
IN–PORT FEEDING SYSTEM
SHIPBOARD PERSONNEL
FOOD SERVICE EQUIPMENT
CAPACITY (QUANTITY)

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

An investigation was conducted to determine the potential of utilizing existing dining facilities to preprocess foods for satellite feeding operations on or near the pier area. This system would provide foodservice to surface ship crew members during extended in-port periods. It was determined that the dining facilities selected for the analysis have sufficient foodservice equipment and facility capacity to support these outlets. However, this alternative does require additional foodservice labor and may necessitate the utilization of shipboard foodservice personnel while in port. This report is volume 3 of a four-volume series. The other titles

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20. ABSTRACT (continued)

are volume 1, An In-Port Feeding System for Shipboard Personnel; volume 2, A Cost Benefit Analysis of the Use of Convenience Foods in a Military Foodservice Operation; and volume 4, Recommended Quality Control Requirements for a Central Military Food Service System.

PREFACE

During FY80 to FY82 the Operations Research and Systems Analysis Office at the US Army Natick Research and Development Laboratories (NLABS) conducted an investigation of the Navy in-port feeding system under Task AA, Project 1L162724AH99A, Analysis and Design of Military Feeding Systems, of the DoD Food Research Development Testing and Engineering Program. The military service requirement identification was USN 9–2 In-port Feeding Systems for Shipboard Personnel. The purpose of this project was to develop and evaluate analytically alternative foodservice system concepts for providing meals to surface ship crew members during extended in-port periods. In particular, a system was desired to reduce onboard foodservice personnel labor requirements to provide the cooks time for leave, liberty, and training comparable with that enjoyed by other members of the crew, and, secondly, to reduce the loss of ships' force overhaul productivity resulting from messing delays. In addition, the proposed system was to provide highly acceptable and nutritious meals at a quality level that was equal to or better than that presently being served to shipboard personnel while in port.

As a means of reducing shipboard foodservice labor requirements during extended in-port periods, the use of convenience foods was proposed (see volume 1 in this series, NATICK/TR–83/035). Subsequent analyses illustrated that the utilization of commercially prepared convenience-type foods would reduce shipboard Mess Management Specialists labor requirements (volume 1, NATICK/TR–83/035 and volume 2, NATICK/TR–83/036). In order to determine the feasibility of utilizing existing dining facilities to preprocess foods for feeding surface ship crew members at satellite outlets during extended in-port periods, an Intergovernmental Personnel Act was awarded to Frank D. Borsenik, Phd., University of Nevada, Las Vegas, Nevada. This investigation focussed on two enlisted dining facilities; Naval Air Station North Island, CA and Naval Station, San Diego, CA.

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I. INTRODUCTION

Two enlisted dining facilities (EDF), NAS North Island and NAVSTA San Diego, were investigated to determine their capabilities and capacity to preprocess food for satellite feeding operations. Specifically, personnel requirements, equipment capacity, and the facilities were evaluated to determine the maximum feasible meal output of the EDFs with a minimum of new equipment and facility changes. The processed foods would be trucked from the EDFs to onshore satellite foodservice areas, or directly to in-port ships for the plating and serving of meals. As an example of large-scale, in-port shipboard feeding, a carrier was used for the EDF NAS North Island.

Additionally, the project was conducted by the Operations and Systems Analysis Office of the US Army Natick R&D Laboratories as part of the DoD Food Research, Development, Test, and Engineering Program. This report was done under an Inter-Governmental Personnel Agreement (IPA) between the University of Nevada, Las Vegas, and the US Army Natick R&D Laboratories.

II. OBJECTIVES

The primary purposes of this report are the following.

1. To evaluate EDF NAS North Island and EDF NAVSTA San Diego in respect to current employee productivity; kitchen equipment requirements to produce current rations; subsistence storage requirements to meet current ration needs and to use these three measures as bases for analyzing the remaining two objectives.

2. To assess the present capacity of each EDF in terms of personnel, equipment and facilities to support additional food preparation for distribution and serving at remote locations on the base.

3. To determine the additional resources in terms of personnel, equipment, and facilities to support additional food preparation requirements.

III. SUMMARY: CONCLUSIONS AND RECOMMENDATIONS

Both EDF NAVSTA San Diego and EDF NAS North Island have equipment and facility capacity to produce additional meals if additional employees are provided at each facility.

Two alternatives are available at each facility. First, additional rations could be prepared and served at each facility if meal service hours are extended, and if additional personnel are added to each EDF as a second work shift. No additional equipment or facilities would be required in this case. Food would have to be procured at least three times per week. The

EDF NAVSTA San Diego would require an additional 93 workers to provide an additional 2,000 rations per day, or 14,000 rations per week. The EDF NAS North Island would require an additional 97 workers to provide an additional 1,300 rations per day, or 9,100 rations per week.

The second alternative is that each EDF could be utilized to process meals for remote foodservice areas. In this case, a second, equivalent-size work crew is recommended at each or both EDFs. The second crew would work five days per week, generally from 1800 to 0600 hours. Kitchen equipment is adequate, so no new equipment is required if food is procured at least three times per week. Specifically, EDF NAVSTA San Diego would have a second work shift of 32 persons, who would have a weekly meal output of 20,000 and would require a blast freezer (–30°F) that has a daily product load, excluding transmission, infiltration, and appliance heat loads, of 1,500,000 Btu. The EDF NAS North Island would have a second work shift of 62 persons, who would have a weekly meal output of 21,000 and would require a blast freezer (–30°F) that has a daily product load, excluding transmission, infilitration, and appliance heat loads of 1,700,000 Btu.

The frozen food would be trucked to remote foodservice areas for reconstitution, plating, and service. The EDF NAS North Island could fully service an in-port carrier with the second alternative's work force and still produce over 6,000 meals per week.

IV. SELECTION RATIOS OF FOOD ITEMS

The EDF NAVSTA San Diego and EDF NAS North Island office personnel maintain records of the selection of some food items for each menu period (breakfast, lunch, and dinner). These data were tabulated and the items combined into similar food groups. The records followed no consistent rule on the EDF menu regarding the type of food item. For example, on the item potatoes, the EDF menu sometimes listed a specific type of potato and in other cases only the word potato. For example, the published menu may mention potatoes or creamy whipped potatoes, O'brien potatoes, cottage fried potatoes, french fried potatoes, french baked potatoes, scalloped potatoes, lyonnaise potatoes, oven browned potatoes, snowflake potatoes, or rissole potatoes. Hence, potatoes were grouped together into one group. Similar food groupings were made for other food items because of the lack of specific information on the menu regarding the specific offering. The mean selection percentage and standard deviation were computed for each food grouping and are shown in Table 1.

The EDF NAVSTA San Diego was utilizing a 21-day menu. The computational results in Table 1 are for one complete menu cycle in June 1980. The EDF NAS North Island was utilizing a 35-day menu and the computational results in Table 1 reflect the selection of food items from 2 June 1980 through 30 June 1980.

The original food selection data and computational results shown in Table 1 were analyzed to determine if there was a significant difference between the selection of food items at the different dining facilities. (For example, is there a significant difference between bacon at EDF NAS North Island with a mean of 71.68% and at EDF NAVSTA San Diego with a mean of 71.20%?) If there was no significant difference between facilities for a particular food

Table 1

Selection ratios, mean and standard deviation, and sample size for food items by meal period for EDF NAS North Island and EDF NAVSTA San Diego for the June 1980 menu cycle

Food item by meal period	EDF NAS North Island			EDF NAVSTA San Diego		
	X	S.D.	N	X	S.D.	N
Breakfast						
Meat items:						
1. Bacon	71.68	19.92	28	71.20	9.02	10
2. Beef	10.86	3.66	14	33.89	13.65	9
3. Bologna	12.70	3.95	10	31.60	7.02	5
4. Ham	35.26	6.91	19	47.33	19.66	3
5. Lunch Meat	11.25	3.77	4	48.60	20.77	5
6. Pork	36.72	13.70	18	44.40	18.20	10
Other items:						
7. Biscuits	33.12	16.92	33		No data	
8. French Toast	33.94	13.82	17		No data	
9. Hot Cakes	26.24	9.32	17		No data	
10. Oatmeal/Farina	8.29	4.11	7	25.00	0	1
11. Potatoes	76.06	17.87	31	50.00	0	1
Lunch						
12. Soup	26.92	7.20	36	43.95	12.56	21
Meat items:						
13. Beef/Veal	55.25	17.50	20	37.38	11.26	8
14. Poultry	57.67	22.98	9	63.67	18.53	6
15. Fish	45.80	16.15	5	57.75	35.85	4
16. Pork/Ham	50.56	11.66	9	61.00	18.18	5
17. Steak	55.60	8.08	5	44.67	13.05	3
18. Other Meat	51.33	11.02	3		No data	
Vegetables:						
19. Beans	36.33	15.93	9	41.57	15.31	7
20. Beets	18.25	6.99	4	23.00	0	1
21. Broccoli	51.40	2.41	5	39.50	.71	2
22. Brussels Sprouts	32.00	34.89	3	33.00	15.56	2
23. Cabbage/Cauliflower	36.50	12.79	6	44.40	22.12	5
24. Carrots	44.00	5.20	3	29.33	13.66	6
25. Corn	86.30	12.04	10	61.40	15.87	5
26. Greens, Mixed	55.50	9.69	6	38.00	19.80	2
27. Peas	42.60	5.68	5	44.00	22.17	5
28. Potatoes	74.04	25.87	23	59.89	24.75	18

Table 1 (cont'd)

Food item by Meal Period	EDF NAS North Island X	S.D.	N	EDF NAVSTA San Diego X	S.D.	N
29. Rice	59.22	10.10	23	52.08	11.89	13
30. Spinach	34.00	19.30	2	53.00	0	1
31. Squash		No data			No data	
32. Succotash	51.33	11.02	3		No data	
33. Tomatoes		No data		31.00	26.27	2
Other items:						
34. Dressing	58.57	16.16	7	40.00	0	1
35. Gravy	62.50	19.98	22	43.07	13.41	14
36. Noodles, Macaroni and Cheese	39.57	26.78	7	39.50	23.33	2
37. Rolls	38.53	13.76	32		No data	
38. Sauces	21.00	0	1	47.50	22.93	4
Dinner						
39. Soup	26.86	7.62	36	48.86	13.79	21
Meat items:						
40. Beef	53.43	18.02	14	51.30	19.28	20
41. Poultry	64.80	26.59	15	68.00	7.21	3
42. Fish	44.00	14.73	3	71.00	0	1
43. Pork Ham	50.86	24.82	14	35.29	13.69	7
44. Steak	62.00	17.31	6	62.00	11.79	3
45. Other Meat	45.86	28.29	22	57.88	21.37	8
Vegetables						
46. Asparagus		No data		44.00	4.58	3
47. Beans	46.47	22.88	15	32.40	16.44	5
48. Beets	20.75	3.77	4	10.33	8.62	3
49. Broccoli	52.00	15.18	5	48.67	18.77	3
50. Brussels Sprouts	28.00	8.49	2	35.00	10.00	3
51. Cabbage/Cauliflower	41.80	15.97	5	60.33	36.50	3
52. Corn	81.82	21.35	11	55.83	26.08	3
53. Carrots	53.50	18.28	6	32.25	14.41	4
54. Greens, Mixed	48.36	18.15	11	44.33	15.91	6
55. Peas	54.00	29.94	7	42.75	19.72	4
56. Potatoes	72.41	22.48	32	55.78	16.57	18
57. Rice	63.46	15.65	26	55.88	19.82	17
58. Spinach	56.50	7.78	2	72.00	0	1
59. Squash		No data		41.00	30.07	4

Table 1 (cont'd)

Food item by meal period	EDF NAS North Island X	S.D.	N	EDF NAVSTA San Diego X	S.D.	N
60. Succotash	65.00	0	1	36.00	0	1
61. Tomatoes	33.50	3.54	2		No data	
Other items:						
62. Dressing/Noodles	67.89	22.68	18	58.00	31.35	4
63. Gravy	81.60	13.36	20	43.31	18.78	13
64. Rolls	34.00	13.42	34	42.00	0	1
65. Sauces	38.60	18.53	5	30.67	14.17	6

item, the data were pooled. In some cases similar food items were also pooled if statistically possible. For exampie, EDF NAS North Island breakfast meats such as beef with a mean of 10.86% and lunch meat with a mean of 11.25% were pooled because there was no significant difference in the data. The results of this pooling analysis are shown in Table 2. It should be noted that when the computational means and standard deviations are equal for various food items, there is no significant difference in the data.

Food selection data were correlated to the number of daily change food items by meal period. Beverages, salads, and desserts were excluded from this analysis as foodservice personnel generally did not maintain food selection data for these items, except for rolls at EDF NAS North Island. The correlated statistic will indicate the number of full servings of food items obtained by each consumer from the available food items. An example of the statistic is shown in Table 3.

The 3.58 statistic shown in Table 3 represents the number of full servings obtained by each consumer. Each person obtained about 0.50 (3.58/7) servings of each daily change food item. A perfect service acceptance statistic would be 7.00 for the seven food items. This statistic should correlate to the individual selection data. The above data also include double portions or servings of the same food item. If the statistic does not correlate to the individual selection data, it indicates that consumers have combination food selection preferences. For example, they could prefer corn with roast beef. If, however, the statistic correlates, it would indicate that the acceptance and selection of corn is a true preference factor and not generally dependent on other combination food offerings with corn. The independence of selection data will be shown later.

The total food acceptance statistic was determined for each meal period, each day, and at both facilities. This statistic was analyzed by analysis of variance techniques to determine if a significant difference existed between days of the week. There was no significant difference between days of the week. The only significant difference was that the statistic varied with the number of offered daily change food items.

The dependence of the total food acceptance statistic on the number of daily change food items was analyzed by covariance techniques. It was determined that there was no significant difference between dining facilities for the same meal periods (breakfast, lunch, and dinner), hence, the data could be pooled for these meal periods. Also, there was no significant difference between lunch and dinner meal periods, hence these data were pooled. The results of these computations are shown in Table 4.

The computational results from previous Tables 1 and 4 are shown in Table 5 for EDF NAS North Island for a five-day period. The actual food selection percentages are indicated (from actual reported data), the mean selection percentages are shown (Table 1), and the total food acceptance from the available food items (Table 4) are indicated for each meal period. These comparisons indicate the reliability of the projections from Tables 1 and 4.

Table 2

Selection ratios (based on pooling of similar data) from Table 1

Food item by meal period	EDF NAS North Island X	EDF NAS North Island S.D.	EDF NAVSTA San Diego X	EDF NAVSTA San Diego S.D.	Combined X	Combined S.D.
Breakfast						
Meat items:						
1. Bacon					73.36	20.52
2. Beef						
3. Bologna	10.91	3.98	30.96	11.98		
4. Lunch Meat						
5. Ham						
6. Pork					37.00	14.99
Other items:						
7. French Toast						
8. Hot Cakes	30.96	11.98				
9. Oatmeal/Farina					10.91	3.98
Lunch						
Meat items:						
10. Poultry					62.84	19.11
11. Steak					55.83	16.87
12. Beef/Veal						
13. Fish					50.68	22.54
14. Pork/Ham						
Vegetables:						
15. Beets					17.00	7.31
16. Brussels Sprouts					31.54	15.23
17. Beans						
18. Broccoli						
19. Cabbage/Cauliflower					45.38	17.36
20. Greens, Mixed						
21. Peas						
22. Spinach						
23. Corn						
24. Potatoes			55.83	16.87		
25. Rice						
26. Succotash						
27. Carrots	45.38	17.36				
28. Tomatoes			31.54	15.23		
Other items:						
29. Dressing						
30. Noodles, Macaroni and Cheese					45.59	16.06
31. Sauces					37.00	14.99

Table 2 (cont'd)

Food item by meal period	EDF NAS North Island X	EDF NAS North Island S.D.	EDF NAVSTA San Diego X	EDF NAVSTA San Diego S.D.	Combined X	Combined S.D.
Dinner						
Meat items:						
32. Beef						
33. Fish						
34. Pork/Ham					50.68	22.54
35. Other Meats						
36. Steak					55.83	16.87
37. Poultry					62.84	19.11
Vegetables:						
38. Beets					17.00	7.31
39. Brussels Sprouts					31.54	15.23
40. Beans						
41. Broccoli						
42. Cabbage/Cauliflower					45.38	17.36
43. Greens, Mixed						
44. Peas						
45. Spinach						
46. Succotash						
47. Potatoes						
48. Rice			55.83	16.87		
Other items:						
49. Dressing/Noodles					62.84	19.11
50. Rolls					55.83	16.87
51. Sauces					37.00	14.99
Other pooling						
52. Potatoes:						
Breakfast						
Lunch	73.36	20.52				
Dinner						
53. Rice:			55.83	16.87		
Lunch	62.84	19.11				
Dinner						
54. Soup:						
Lunch	26.84	7.34	45.59	16.06		
Dinner						
55. Corn:						
Lunch			55.83	16.87		
Dinner	82.80	15.34				
56. Gravy:						
Dinner						

Table 3

Food selection of daily change food items at EDF NAVSTA San Diego for lunch on 3 June 1980

Food Item*	Actual Selection %	Actual Selection Decimal
Beef Noodle Soup	42	0.42
Roast Fresh Pork	72	.72
Tuna Chopsticks	33	.33
Rich Pork Gravy	58	.58
Parsley Buttered Potatoes	65	.65
Steamed Rice	52	.52
Seasoned Cauliflower	36	.36
Total (decimal)		3.58

*Food items for which selection data were maintained.

Table 4

Calculation of total food acceptance from available food items at a meal period at EDF NAVSTA San Diego and EDF NAS North Island

Notations: All Meal Periods

X = number of available menu items, excluding beverages, salads, desserts at both facilities and rolls at EDF NAVSTA San Diego.

Y = number of full servings selected per consumer.

For example:

If: X = 5

Y = 2.0996 full servings will be selected per consumer.

A. Breakfast meal period:

$Y = 0.2161 + 0.3767X$

$R_{yx} = 0.8853$

$S_{yx} = 0.3896$

$S_y = 0.0574$

B. Lunch and Dinner meal period:

$Y = -1.0551 + 0.6434X$

$R_{yx} = 0.7934$

$S_{yx} = 0.7835$

$S_y = 0.0791$

Table 5

Comparison of actual food selection data to projected food selection of a five-day period for EDF NAS North Island (projected food selection and total acceptances are from Tables 1 and 4)

	Actual (%)	Projected (%)
A. Breakfast menu items:		
02 June, 1980		
Bacon Slices	65	71.68
Grilled Ham Slices	34	35.26
Creamed Beef Slices	8	10.86
Hash Brown Potatoes	92	76.06
Hot French Toast	28	33.94
Hot Griddle Cakes	21	26.24
Hot Biscuits	34	33.12
Total, decimal	2.82	2.87
Error		0.37
Total projected (Table 4): 7 items; 2.85 ± 0.39		
03 June,1980		
Hot Oatmeal	10	8.29
Bacon Slices	65	71.68
Grilled Lunch Meat	6	11.25
Pork Sausage Patties	36	36.72
Home Fried Potatoes	35	76.06
French Toast	25	33.94
Hot Griddle Cakes	19	26.24
Biscuits	18	33.12
Total, decimal	2.14	2.97
Error		0.39
Total projected (Table 4): 8 items; 3.23 ± 0.39		
04 June, 1980		
Bacon Slices	63	71.68
Ham Slices	41	35.26
Minced Beef	10	10.86
Hash Brown Potatoes	64	76.06
French Toast	25	33.94
Hot Cakes	19	26.24
Biscuits	40	33.12
Total, decimal	2.62	2.87
Error		0.37
Total projected (Table 4): 7 items; 2.85 ± 0.39		

Table 5 (cont'd)

	Actual (%)	Projected (%)
05 June, 1980		
Farina	4	8.29
Bacon Slices	77	71.68
Pork Sausage Patties	30	36.72
Ham Slices	34	35.26
Home Fried Potatoes	64	76.06
Total, decimal	2.09	2.28
Error		0.31
Total projected (Table 4): 5 items; 2.10 ± 0.39		
06 June, 1980		
Bacon Slices	67	71.68
Ham Slices	30	35.26
Creamed Ground Beef	9	10.86
Hash Brown Potatoes	80	76.06
French Toast	26	33.94
Hot Cakes	19	26.24
Biscuits	25	33.12
Total, decimal	2.56	2.87
Error		0.37
Total projected (Table 4): 7 items; 2.85 ± 0.39		
B. Lunch menu items:		
02 June, 1980		
Creole Soup	22	26.92
Chopped Steak	49	55.60
Gravy	68	62.50
Pepper Steak	46	55.60
Potatoes	44	74.04
Green Rice	62	59.22
Corn-on-Cob	81	86.30
Lima Beans	14	36.33
Rolls	42	38.53
Total, decimal	4.28	4.95
Error		0.44
Total projected (Table 4): 9 items; 4.74 ± 0.78		

Table 5 (cont'd)

	Actual (%)	Projected (%)
03 June, 1980		
Chicken Soup	28	26.92
Chicken	85	57.67
Duck	20	57.67
Gravy	95	62.50
Potatoes	66	74.04
Rice	76	59.22
Dressing	76	58.57
Corn	77	86.30
Peas	46	42.60
Rolls	49	38.53
Total, decimal	6.18	5.64
Error		0.54
Total projected (Table 4): 10 items; 5.38 ± 0.87		
04 June, 1980		
French Onion Soup	18	26.92
Corned Beef	21	55.25
Pot Roast	64	55.25
Gravy	64	62.50
Potatoes	53	74.04
Rice	46	59.22
Cabbage	34	36.50
Peas/Carrots	47	42.60
Rolls	43	38.53
Total, decimal	3.90	4.51
Error		0.47
Total projected (Table 4): 9 items; 4.74 ± 0.54		
05 June, 1980		
Beef Noodle Soup	20	26.92
Chili	45	51.33
Pork	49	50.56
Potatoes	45	74.04
Rice	77	59.22
Succotash	64	51.33
Brussel Sprouts	31	32.00
Rolls	44	38.53
Total, decimal	3.75	3.84
Error		0.51
Total projected (Table 4): 8 items; 4.09 ± 0.54		

Table 5 (cont'd)

	Actual (%)	Projected (%)
06 June, 1980		
Chowder	30	26.92
Perch	49	45.80
Meat Loaf	56	51.33
Gravy	76	62.50
Potatoes	74	74.04
Rice	58	59.22
Dressing	69	58.57
Spinach	20	34.00
Corn-on-Cob	96	86.30
Rolls	50	38.53
Total, decimal	5.78	5.37
Error		0.51

Total projected (Table 4): 10 items; 5.38 ± 0.54

C. Dinner menu items:

02 June, 1980		
Bean Soup	28	26.86
Beef Roast	76	53.43
Gravy	78	81.60
Chicken	36	64.80
Potatoes	64	72.41
Vermicelli	37	67.89
Green Beans	26	46.47
Cauliflower	34	41.80
Rolls	60	34.00
Total, decimal	4.39	4.89
Error		0.57

Total projected (Table 4): 9 items; 4.74 ± 0.54

03 June, 1980		
Potato Soup	26	26.86
Stuffed Cabbage	16	45.38
Pork	48	50.86
Potatoes	49	72.41
Rice	79	63.46
Broccoli	42	52.00
Beets	20	20.75
Rolls	56	34.00
Total, decimal	3.36	3.66
Error		0.52

Total projected (Table 4): 8 items; 4.09 ± 0.54

Table 5 (cont'd)

	Actual (%)	Projected (%)
04 June, 1980		
Corn Chowder Soup	20	26.86
Stew	69	53.43
Stuffed Franks	45	45.86
Macaroni/Cheese	68	67.89
Rice	71	63.46
Spinach	62	56.50
Beans	23	46.47
Rolls	53	34.00
Total, decimal	4.11	3.94
Error		0.52
Total projected (Table 4): 8 items; 4.09 ± 0.54		
05 June, 1980		
Chicken Noodle Soup	23	26.86
Steak	46	62.00
Chicken	40	64.80
Chop Suey	28	45.86
Potatoes	52	72.41
Rice	72	63.46
Beets	16	20.75
Broccoli	33	52.00
Rolls	53	34.00
Total, decimal	3.63	4.42
Error		0.55
Total projected (Table 4): 9 items; 4.74 ± 0 54		
06 June, 1980		
Pea Soup	22	26.86
Chicken	61	64.80
Pork Loin	35	50.86
Gravy	95	81.60
Potatoes	73	72.41
Rice	69	63.46
Dressing	56	67.89
Beans	54	46.47
Cauliflower	24	41.80
Rolls	54	34.00
Total, decimal	5.43	5.50
Error		0.62
Total projected (Table 4): 10 items; 5.38 ± 0.54		

V. MEALS PER MEAL PERIOD

A forecast estimates the number of food servings to prepare for a given meal period. An experienced Food Service Officer is essential for an accurate forecast, which is used for food purchasing and production schedules. Facility experience is essential for accurate forecasting because knowledge of station work activities, personnel (consumer) leave patterns, base illness, weather, in-port ships, weekday vs. weekend days, the influence of paydays, holiday schedules, local (city and base) activities, and military operations may all influence facility eating patterns (headcounts). Without this knowledge and specific facility experience, it becomes necessary to use past data to forecast eating patterns that could result in high deviations from normal patterns.

The actual number of meals served for a full menu cycle at EDF NAVSTA San Diego (21 days) and for an almost complete menu cycle (30 days of the 35 day menu cycle) at EDF NAS North Island were analyzed to determine if food service headcount patterns by meal period and weekday could be estimated.

EDF NAS North Island had two foodservice patterns, a "normal" pattern and a second that includes the feeding of personnel when a carrier was inport during the June portion of the menu cycle. EDF NAS North Island also prepared mid-rations (MIDRATS).

The original data were grouped by meal period for each EDF and separated at EDF NAS North Island into "normal" and "w/Carrier" (see Table 6). Analysis of variance techniques were used to determine if a statistical significant difference existed between days, facilities, and carrier influence. If there was no significant difference (at the five percent level) the original data was pooled or combined resulting in equal or identical forecasts for some days of the week. The results are shown in Table 7.

Each EDF has a "speedline" foodservice area. This is a short-order food production and service area. Selected food items are offered along with many food items offered on the normal food menu for the day, such as soup, beverages, salads, desserts, and rolls.

The only EDF to provide daily speedline data was EDF NAVSTA San Diego. The EDF maintained records for the total servings* per meal period and the number of servings served in normal (nonspeedline) service. The difference between the total servings and normal service servings being equal to the number of speedline servings.

The actual speedline data were analyzed by meal periods and days of the week for which the speedline was in operation (see Table 8). The data were pooled whenever statistically possible at the five percent significance level. The results are reported as a percentage of the total number of meals served in Table 9 for EDF NAVSTA San Diego. Similar data were not provided by EDF NAS North Island.

The results shown in Tables 6, 7, 8, and 9 can be used to estimate or forecast total normal and speedline servings. These will be shown in Table 10. While speedline data was not obtained for EDF NAS North Island, it was assumed that EDF NAVSTA San Diego speedline data could be used for EDF NAS North Island.

*Servings are the same as headcounts in this section.

Table 7

Pooling of meals (mean and standard deviation) per meal period from Table 6

	Day	EDF NAVSTA San Diego X	EDF NAVSTA San Diego S.D.	EDF NAS North Island Normal Operations X	EDF NAS North Island Normal Operations S.D.	EDF NAS North Island w/Carrier X	EDF NAS North Island w/Carrier S.D.
Breakfast:							
	Mon, Sat, Sun	575.67	87.01				
	Tues, Wed, Thurs, Fri	767.58	43.80				
	Mon, Tues, Wed, Thurs			728.00	24.67		
	Fri			627.00	65.05		
	Sat, Sun			424.89	71.19	424.89	71.19
	Mon, Tues, Wed, Thurs, Fri					825.50	60.28
Lunch:							
	Mon, Tues, Wed, Thurs, Fri	1,329.59	139.78				
	Sat, Sun	749.50	334.93	749.50	334.93	749.50	334.93
	Mon			1,214.00	18.38		
	Tues, Thurs			1,329.59	139.78		
	Wed, Fri			1,444.00	173.85		
	Mon, Tues, Wed, Thurs					1,605.33	165.79
	Fri					1,101.00	152.74
Dinner:							
	Mon, Tues, Wed, Thurs, Sun	1,072.86	117.68				
	Fri, Sat	774.81	216.43				
	Mon, Fri, Sat, Sun			774.81	216.43		
	Tues, Wed, Thurs			991.67	42.71		
	Mon, Tues, Wed, Thurs					1,184.00	100.88
	Fri, Sat, Sun					774.81	216.43
MIDRATS:							
	Mon, Tues, Wed, Thurs, Fri			394.35	94.05		
	Sat, Sun			123.50	48.79		
	Mon, Tues, Wed, Fri, Sat, Sun					394.35	94.05
	Thurs					762.67	229.77

Table 8

Percentage (mean and standard deviation) of total meals served as "speedline meals" at EDF NAVSTA San Diego for a 21-day menu cycle in June 1980

	Speedline Meals as % of Total					
	Breakfast		Lunch		Dinner	
Day	X	S.D.	X	S.D.	X	S.D.
Monday	22.80	1.35	39.70	2.30	35.90	6.77
Tuesday	21.33	0.70	39.91	1.55	33.73	1.57
Wednesday	21.66	1.08	43.87	2.59	36.47	0.90
Thursday	21.66	1.28	41.67	6.48	34.35	3.54
Friday	25.44	1.54	34.99	6.06	37.91	0.26
Saturday	34.21	2.20	None		45.86	10.25
Sunday	32.79	4.95	None		40.98	4.30

Table 9

Pooling of speedline meals from Table 8

	Speedline Meals as % of Total	
	X	S.D.
Breakfast:		
Mon, Tues, Wed, Thurs	21.86	1.13
Fri	25.44	1.54
Sat, Sun	33.50	3.51
Lunch:		
Mon, Tues, Wed, Thurs, Fri	37.86	4.54
Sat, Sun	None	
Dinner:		
Mon, Tues, Wed, Thurs, Fri	37.86	4.54
Sat, Sun	43.42	7.52

Table 10

Meals per meal period by speedline and normal foodservice at EDF NAVSTA San Diego and EDF NAS North Island for the June 1980 menu cycles, based on Tables 7 and 9

		EDF NAVSTA San Diego		EDF NAS North Island			
				Normal Operations		w/Carrier	
Meal period estimates:		Speedline	Nonspeedline	Speedline	Nonspeedline	Speedline	Nonspeedline
Breakfast:							
Mon	X	125.84	449.83				
	S.D.	6.51	80.50				
Tues, Wed, Thurs	X	167.79	599.79				
	S.D.	8.67	35.13				
Fri	X	195.27	572.31			210.01	615.49
	S.D.	11.82	31.98			12.71	47.57
Sat, Sun	X	177.82	397.85	131.25	293.64	131.25	293.64
	S.D.	31.03	55.98	22.90	48.29	22.90	48.29
Mon, Tues, Wed, Thurs	X			159.14	568.86	180.45	645.05
	S.D.			8.23	16.44	9.33	50.95
Lunch:							
Mon, Tues, Wed, Thurs, Fri	X	515.75	813.84				
	S.D.	72.60	67.18				
Sat, Sun	X	None	749.50	None	749.50	None	749.50
	S.D.	—	334.93	—	334.93	—	334.93
Mon	X			470.91	743.09		
	S.D.			66.28	—		
Tues, Thurs	X			515.75	813.84		
	S.D.			72.60	67.18		
Wed, Fri	X			560.13	883.87		
	S.D.			78.84	95.01		
Mon, Tues, Wed, Thurs	X					622.71	982.62
	S.D.					87.65	78.14
Fri	X					427.08	673.92
	S.D.					60.11	92.63

Table 10 (cont'd)

Meal period estimates:		EDF NAVSTA San Diego		EDF NAS North Island Normal Operations		EDF NAS North Island w/Carrier	
		Speedline	Nonspeedline	Speedline	Nonspeedline	Speedline	Nonspeedline
Dinner:							
Mon, Tues, Wed, Thurs	X	416.16	656.70				
	S.D.	58.58	59.10				
Fri	X	300.55	474.26				
	S.D.	42.30	174.13				
Sat	S	293.58	481.23				
	S.D.	45.71	170.72				
Sun	X	406.51	666.35				
	S.D.	63.30	54.38				
Mon, Fri	X			300.55	474.26		
	S.D.			42.30	174.13		
Tues, Wed, Thurs	X			384.67	607.00		
	S.D.			54.15	–		
Sat, Sun	X			293.58	481.23	293.58	481.23
	S.D.			45.71	170.72	45.71	170.72
Mon, Tues, Wed, Thurs	X					459.27	724.73
	S.D.					64.65	36.23
Fri	X					300.55	474.26
	S.D.					42.30	174.13

NOTE: It is assumed speedline data at EDF NAVSTA San Diego apply to EDF NAS North Island

VI. LABOR AND EMPLOYEE PRODUCTIVITY

A. Employee Work Schedule

Each EDF provided a list of its current employees, or the employees involved with the procurement, storage, preparation, processing, service, and facility housekeeping. The actual work schedule for civilian employees at EDF NAVSTA San Diego was given with "off days." The general time schedule for military personnel was indicated. Military personnel are not subject to a typical eight-hour daily work schedule as are civilian employees. The military may work from 0500 to 1800, or 1800 to 0500 hours, as two examples. Military personnel may work five days, have two days off, work two more days, and have several more days off. Actual work hours are a function of the work that must be done on a particular day. It becomes very difficult to estimate or actually determine military personnel working hours without making physical observations for each employee. These observations were not made, hence, typical meals per employee hour productivity ratios could only be estimated.

Another factor became evident: the manhour requirement for the various meal periods could not be determined without on-the-site observations, which were not made. All productivity measures will be in reference to total meals served at each EDF for a period of time per worker.

Table 11 indicates the total number of personnel assigned by work areas in each EDF, and civilian personnel are indicated for EDF NAVSTA San Diego and a special notation is made for EDF NAS North Island when a carrier was in port.

B. Worker Productivity

Normal industry worker productivity figures are generally stated as meals per manhour. As indicated in the previous section, this measurement (meals per manhour) at best is only an estimate for both EDFs. Perhaps a much more reliable figure for these facilities is meals per worker per week, which minimizes the daily variations in productivity because of daily eating patterns, headcounts, and worker scheduled days off which may not always be followed. Both productivity ratios are shown in Table 12.

Table 13 represents a comparison of worker productivity ratios for various military and some civilian operations and is shown for comparative purposes only. It should be noted that employee productivity at EDF NAS North Island is well below the data for EDF NAVSTA San Diego. The data are within and generally have higher ranges than other military foodservice operations. The only apparent reason for the high productivity at EDF NAVSTA San Diego could be caused by the civilian employee group at that unit. EDF NAS North Island data should probably be used as more reliable data for projecting productivity estimates for future facility planning, unless a decision is made regarding greater use of civilian employee cooks.

One conclusion could be developed based on Tables 12 and 13 and is shown in Table 14. Table 14 is the projected meal production of EDF NAS North Island if it were as productive as EDF NAVSTA San Diego. The excess meals that could be prepared in one week are indicated.

Table 11

Personnel by work area at EDF NAVSTA San Diego and EDF NAS North Island during June 1980

Personnel work activity	EDF NAVSTA San Diego			EDF NAS North Island	
	Military	Civilian	Total	Normal operations	w/Carrier
Bake Shop	5	0	5	10	12
Butcher Shop	2	0	2	2	2
DHMAA Force	0	9	9	8	11
Flight Galley	0	0	0	3	3
Galley	12	7	19	29	48
Speedline	3	0	3	4	4
Stores	3	0	3	6	7
Records	3	0	3	12	12
Total	28	16	44	74	99

Table 12

Worker productivity at EDF NAVSTA San Diego and EDF NAS North Island in June 1980

	EDF NAVSTA San Diego	EDF NAS North Island Normal Operations	EDF NAS North Island w/Carrier
Meals per Week:			
Breakfast	4,797.33	4,388.78	4,977.28
Lunch	8,146.95	8,260.18	9,021.32
Dinner	6,913.92	6,074.25	7,060.43
MIDRATS	–	2,218.75	3,128.77
Total	19,858.20	20,941.96	24,187.80
Scheduled Workers:			
Total	44	74	99
Total excluding DHMAA force	36	66	88
Total excluding record	41	62	87
Total excluding DHMAA force and records	32	54	76

Productivity:

	Meals/Worker/ Week	Meals/ Manhour	Meals/Worker/ Week	Meals/ Manhour	Meals/Worker/ Week	Meals/ Manhou
Total	451.32	10.39	283.00	5.16	244.32	4.33
Total excluding DHMAA force	551.62	12.80	317.30	5.83	274.86	4.89
Total excluding records	484.35	11.40	337.77	5.84	278.02	4.74
Total excluding DHMAA/records	620.57	14.37	387.81	6.73	318.26	5.42

Table 13

Productivity comparisons between EDF NAVSTA San Diego, EDF NAS North Island, and other types of foodservice operations

Organization	Productivity Ratios Meals/Worker/Week	Meals/Manhour
EDF NAVSTA San Diego	451.32	10.39
EDF NAS North Island	283.00	5.16
EDF NAS North Island: w/Carrier	244.32	4.33
MCB Twentynine Palms (with)	221.56	2.65
MCB Twentynine Palms (without)	228.94	3.46
NAS Alameda (without)	162.52	3.32
Travis AFB (with)	154.98	3.87
Travis AFB (without)	211.33	5.28
Air Force (without)	201.15	5.03
Harvard University	129.50	3.23
Beverly Enterprises	263.23	6.58
Atlanta Public Schools	352.31	8.81

NOTE: Other organization source data obtained from US Army Natick Laboratories sources.

Table 14

Projected meal production at EDF NAS North Island based on the assumption that personnel are as productive as EDF NAVSTA San Diego personnel

Scheduled Work Force	Projected Meal Production Normal	w/Carrier
Total	33,397.68	44,680.68
Total excluding DHMAA force	36,406.92	48,542.56
Total excluding records	30,029.70	42,138.45
Total excluding DHMAA/records	33,510.78	47,163.32

A final note regarding Table 14. If EDF NAS North Island were as productive as EDF NAVSTA San Diego, it would have the potential to produce from 9,000 to 15,000 more meals per week under normal operations and from 17,000 to 24,000 more meals per week when additional personnel are assigned, for example from an in-port carrier. These estimates assume that EDF NAVSTA San Diego employee schedules and records are accurate.

Work activity area productivity data are shown in Table 15. Table 11 indicates several categories of personnel work activity areas, such as, bake shop, butcher shop, Dining Hall Master at Arms (DHMAA) force, flight galley, galley, speedline, stores, records, and the number of personnel assigned to each of these areas. Speedline meals for productivity data are taken from Table 10. Total meals served are used for all other than speedline productivity ratios. Flight galley productivity is based on MIDRATS. MIDRATS are excluded from DHMAA force productivity measures.

Table 15 quickly reveals the activity areas that have the largest productivity differences and could be used to establish maximum productivity ratios.

A final note concerning the large differences in worker productivity data shown in the previous tables: the menu offered by each EDF may be totally different. This effect will be investigated in a later section.

VII. SUBSISTENCE STORAGE REQUIREMENTS

Each of the standard recipe cards from the Armed Forces Recipe Service were analyzed to determine the quantity of raw food ingredients and potential processing equipment requirements for the preparation of each recipe item. These quantities were then grouped into either refrigerated (freezer and cooler) storage or dry storage by food group.

In many cases the standard menu indicated a salad bar, but did not indicate the types of salads or dressings that would be prepared for the salad bar. The same menu technique applied for a pastry bar, or bread products. Cold and hot beverages were provided for each meal period, but the specific types of beverages were not indicated.

Some food items, such as beans, had many types and preparation variations. Altogether there were at least 61 recipes involving beans. Beans could be canned, green, with corn baked Italian style, canned kidney, ranch style baked kidney, baked Italian style canned pinto, ranch style canned pinto, refried canned pinto, refried canned, white baked canned, or others. The preparations were numerous – baked with catsup, Boston baked, Italian-style baked, ranch style, refried with cheese, etc. If beans or green beans were listed on the published menu it was not always possible to determine which recipe was used for the preparation of the bean product, or in many cases the specific type of bean. Similar situations applied to other food items.

As indicated above, if the master menu only indicates beans, without specifying the type of bean, one could not determine the processing technique or the state of the raw ingredients from the menu. One could not tell, for example, if the recipe would be for dry beans, for

Table 15

Work activity area productivity data at EDF NAVSTA San Diego and EDF NAS North Island in June 1980

	EDF NAVSTA San Diego		EDF NAS North Island			
			Normal		w/Carrier	
Work Activity Area	Meals/Worker/ Week	Meals/ Manhour	Meals/Worker/ Week	Meals/ Manhour	Meals/Worker/ Week	Meals Manhour
Total	451.32	10.39	283.00	5.16	244.32	4.33
Bake Shop	3,971.64	84.50	2,094.20	38.08	2,015.65	35.57
Butcher Shop	9,929.10	264.78	10,470.98	261.77	12,093.90	302.35
DHMAA Force	2,206.47	55.16	2,340.40	44.56	1,914.46	37.79
Flight Galley	–	–	739.58	13.05	1,042.92	18.40
Galley	1,045.17	20.58	722.14	11.41	503.91	8.01
Speedline	2,141.38	116.81	1,505.88	130.89	1,754.37	151.17
Stores	6,619.40	165.48	3,490.33	66.48	3,455.40	68.13
Records	6,619.40	116.81	1,745.16	43.63	2,015.65	50.39

canned beans, for frozen beans, or for dehydrated beans. Not having knowledge of these variables it became necessary to combine recipe items into food groups as indicated above. Therefore, the food groupings and subsequent analysis of data followed throughout the remainder of this report will be more meaningful. If, however, exact recipes are known, the following model and subsistence storage requirements can be easily adjusted.

A. Food Groups

In an attempt to develop an accurate estimate of food ingredients and the resulting storage requirements, food items were grouped and are shown in Table 16. The data in Table 16 are the average quantity of ingredients per 100 servings for the general food group. These data will be used to estimate the total subsistence storage requirements at each EDF for a one-week period. Table 16 also shows the standard deviation of food quantities for each food group. Table 16 describes refrigerated storage, expressed in pounds per 100 servings; dry storage, expressed in pounds per 100 servings; stock (in some cases food is partially prepared then refrigerated until needed for future processing or held for consumption), expressed in gallons per 100 servings; and equipment that could be used for the processing of the food menu items. While it would be highly desirable to separate "refrigerated" storage into frozen and cooled, or refrigerated, this separation could not be accomplished without knowledge of how each food ingredient item was actually received at each EDF, as noted above. Adjustments for refrigerated and freezer storage requirements will be estimated later in this report.

B. Food Estimates/Meal

Food quantity estimates were made for each meal period for one week at each EDF (EDF NAS North Island for "normal" operations). Table 16 was used to determine food quantities by type of storage. Table 2 was used to determine the selection of the specific menu items and if a specific selection level was not listed in Table 2, a selection ratio of 100 percent was used (this applied to beverages, salads, and desserts). Table 7 was used as an estimate for the meals served (headcounts) per meal period and Table 9 was used to provide speedline data and used when the speedline menu was different from the regular menu.

Three basic assumptions were made in reference to the means and standard deviations given in the above-mentioned tables.

Assumption I. Assumption I is in regard to the number of meals to prepare for each meal period. Table 7 indicates the mean and standard deviation for each meal period for each day of the week by EDF. The mean for a Monday at EDF NAVSTA San Diego for breakfast is 575.67 meals. This is an average for the Mondays in June 1980. The standard deviation for the same day is 87.01 meals. The number of meals to prepare, or the production estimate, should consider the possible deviation. It was assumed that the production should be based on a 95 percent sample, or to satisfy 95 percent of the total potential meals for a Monday. The production estimate for breakfast then becomes:

Breakfast meals (Monday) = 575.67 + 1.645*x87.01

= 718.8, or 720 rounded to the nearest 10 meals.

*1.645 is the "t" statistic applied to the standard deviation to account for 95 percent of the area under a normal curve (one-tail "t").

Table 16

Food subsistence requirements for the preparation of various food menu items by type of storage and potential equipment list required to prepare the food menu group

X: pounds (mean) per 100 servings for refrigerated and dry storage, or gallons of stock per 100 servings.

S.D.: standard deviation in pounds per 100 servings for refrigerated and dry storage, or in gallons per 100 servings for stock.

Food group		Storage			Equipment list
		Refrigerated	Dry	Stock	
Salads	X	15.50	10.18	–	Refrigeration
	S.D.	9.59	8.69	–	Range
					Oven
					Slicer/chopper
Salad dressing	X	2.75	7.66	–	Chopper
	S.D.	2.41	2.45	–	Mixer
					Refrigeration
					Range
Sandwiches	X	22.27	21.62	–	Refrigeration
	S.D.	13.72	9.35	–	Range
					Steam kettle
					Oven
					Griddle
					Toaster
					Slicer
					Fryer
Bread products	X	2.13	14.20	–	Mixer
	S.D.	1.05	4.92	–	Oven
					Proofer
					Range
Glazes (bread)	X	1.28	3.69	–	Range
	S.D.	1.12	2.91	–	Mixer
Dough (bread)	X	4.53	9.34	–	Mixer
	S.D.	4.65	5.08	–	Range
					Proofer
					Oven
					Griddle
					Fryer
Appetizers	X	7.19	14.81	–	Range
	S.D.	4.07	9.98	–	Steam kettle
					Oven
					Refrigeration
Beverages, hot	X	0	3.35	–	Range
	S.D.	0	3.91	–	Steam kettle
					Coffee maker
					Urn
Beverages, cold	X	14.61	10.25	–	Refrigeration
	S.D.	3.50	8.78	–	

Table 16 (cont'd)

Food group		Storage: Refrigerated	Storage: Dry	Stock	Equipment list
Breakfast meats	X	21.56	12.20	–	Range
	S.D.	9.00	8.50	–	Steam kettle
					Oven
					Griddle
Beef	X	35.69	13.64	2.85	Oven
	S.D.	19.33	10.39	1.47	Range
					Steam kettle
					Griddle
					Refrigeration
					Fryer
Steak	X	40.44	11.57	1.50	Griddle
	S.D.	4.42	7.93	0	Oven
					Refrigeration
					Range
Ham	X	23.33	22.43	–	Oven
	S.D.	15.03	15.08	–	Range
					Steam kettle
Poultry	X	56.68	10.57	2.38	Range
	S.D.	12.87	8.10	0.75	Oven
					Steam kettle
					Refrigeration
					Fryer
					Griddle
Fish	X	28.73	12.90	–	Range
	S.D.	20.41	10.88	–	Steam kettle
					Oven
					Refrigeration
					Fryer
					Griddle
Pork	X	48.27	11.77	–	Refrigeration
	S.D.	14.97	11.53	–	Oven
					Steam kettle
					Range
Other meat dishes	X	28.19	21.58	2.75	Steam kettle
	S.D.	14.34	6.86	1.06	Oven
					Range
					Griddle
					Refrigeration
					Fryer
Macaroni, noodles and dressings	X	6.29	14.75	1.38	Range
	S.D.	2.63	6.11	0.18	Steam kettle
					Oven
					Refrigeration
Eggs	X	17.56	4.00	–	Range
	S.D.	4.82	3.37	–	Steam kettle
					Oven
					Griddle
					Refrigeration

Table 16 (cont'd)

Food group		Storage: Refrigerated	Storage: Dry	Stock	Equipment list
Sauces and gravy	X	3.55	8.95	1.25	Steam kettle
	S.D.	4.91	9.51	.54	Refrigeration
					Range
					Oven
Soup, from stock	X	6.45	13.09	4.25	Range
	S.D.	3.96	8.43	1.35	Steam kettle
					Refrigeration
Soup, nonstock	X	12.63	8.00	–	Range
	S.D.	7.67	7.37	–	Steam kettle
					Refrigeration
Breakfast cereals	X	1.50	18.25	–	Range
	S.D.	1.73	9.46	–	Steam kettle
Vegetables:					
Rice	X	4.80	20.29	2.50	Range
	S.D.	2.95	9.36	0	Refrigeration
					Oven
					Steam kettle
					Griddle
Potatoes	X	31.53	7.07	–	Range
	S.D.	15.17	8.70	–	Steam kettle
					Oven
					Fryer
					Griddle
Aspargus	X	21.00	2.00	–	Steam kettle
	S.D.	0	0	–	
Beans	X	8.80	14.88	–	Steamer
	S.D.	7.66	12.49	–	Steam kettle
					Range
					Oven
					Fryer
Beets	X	1.00	30.00	–	Range
	S.D.	0	4.24	–	Steam kettle
Broccoli	X	22.00	1.00	–	Range
	S.D.	1.41	0	–	Steam kettle
					Steamer
					Refrigeration
Brussel sprouts	X	22.50	14.00	–	Steamer
	S.D.	2.12	0	–	Steam kettle
					Range
					Oven
Cabbage/cauliflower	X	10.00	13.11	0.25	Steamer
	S.D.	9.51	11.88	0	Steam kettle
					Range
					Refrigeration
					Oven
					Fryer
					Griddle
Carrots	X	21.50	2.00	–	Range
	S.D.	0.71	0	–	Steam kettle

Table 16 (cont'd)

Food group		Storage: Refrigerated	Storage: Dry	Stock	Equipment list
Corn	X	9.63	22.67	–	Steamer
	S.D.	12.89	12.61	–	Fryer
					Griddle
					Steam kettle
					Range
					Oven
Greens, mixed/other	X	15.55	10.85	–	Range
	S.D.	7.69	13.04	–	Steam kettle
					Oven
					Fryer
					Griddle
Peas	X	12.40	13.00	–	Steamer
	S.D.	9.74	14.17	–	Range
					Steam kettle
Spinach	X	6.00	27.00	–	Oven
	S.D.	0	0	–	
Squash	X	24.75	4.50	–	Oven
	S.D.	3.86	3.79	–	Range
					Steam kettle
					Fryer
Succotash	X	21.00	–	–	Steamer
	S.D.	0	–	–	
Tomatoes	X	16.00	17.00	–	Range
	S.D.	21.21	12.73	–	Steam kettle
					Fryer
Desserts:					
Cookies	X	1.92	10.97	–	Range
	S.D.	1.21	1.85	–	Mixer
					Oven
					Refrigeration
					Chopper/slicer
					Griddle
Pie crusts	X	3.00	9.25	–	Mixer
	S.D.	0	5.30	–	Refrigeration
Meringues	X	2.56	3.21	–	Mixer
	S.D.	0.62	0.73	–	Oven
					Range
Pie, excluding crust	X	7.11	18.08	–	Mixer
	S.D.	10.32	11.10	–	Oven
					Range
					Refrigeration
Soft items	X	5.27	10.29	–	Refrigeration
	S.D.	5.04	4.77	–	Range
					Steam kettle
					Oven
					Mixer
Fillings	X	0.94	7.19	–	Grinder
	S.D.	0.77	4.85	–	Range
					Refrigeration

Table 16 (cont'd)

Food group		Storage Refrigerated	Storage Dry	Stock	Equipment list
Other desserts	X	19.56	13.56	–	Range
	S.D.	18.20	8.98	–	Mixer Oven Refrigeration
Dessert sauces	X	2.66	5.63	–	Mixer
	S.D.	2.62	3.83	–	Range Refrigeration

Source: Armed Forces Recipe Service

Assumption II. Assumption II applies to the potential selection rate of the various menu items. Table 2 indicates the mean and standard deviation for the selection of specific food items and food groups. For example, the mean selection ratio for Breakfast ham is 37 percent and the standard deviation is 14.99 percent. The production estimate for ham should be based on both factors. It was assumed that the production should be based on a 75 percent sample, or to satisfy 75 percent of the potential selection of Breakfast ham. The production estimate for Breakfast ham then becomes, for a Monday:

Ham servings = (0.3700 + 0.6745*x0.1499)x720

= 339.19, or 340 rounded to the nearest 10 servings.

*0.6745 is the "t" statistic applied to the standard deviation to account for 75 percent of the area under a normal curve (one-tail "t").

Assumption III. Assumption III applies to the quantity of food ingredients for a specific menu item. Table 16 indicates the mean and standard deviation of food ingredient quantities for specific groups of food items. For example, the mean number of pounds for Breakfast meat is 21.56 pounds per 100 servings and the standard deviation is 9.00 pounds per 100 servings. The quantity of refrigerated ingredients is a function of both factors, dependent on the type of ham and its preparation. It was assumed that the estimated refrigerated food ingredients should be based on a 75 percent sample, or to satisfy 75 percent of the potential quantity required for all types of Breakfast ham. The refrigerated food ingredient quantity for the Breakfast period for ham then becomes for a Monday:

Refrigerated food ingredients = (21.56 + 0.6745*x9.00)x340

= 93.94 pounds for 340 servings.

*Defined above.

The speedline menu offerings for Breakfast is assumed to be the same as a normal Breakfast period as the published menu did not indicate any differences.

Table 17 shows the results of computations similar to those shown above for EDF NAVSTA San Diego.

Table 18 is a summary for the Breakfast meal period for both EDFs for the same week. Each Breakfast menu was analyzed similar to the procedure indicated for Table 17.

Food quantity estimates were developed for the Lunch meal period for each EDF. A speedline was available for the Lunch meal period Monday through Friday. The Lunch meal period for Saturday and Sunday was called "Brunch" and only one menu was available in all service areas at both EDFs. The food quantity estimate procedure developed for Breakfast was applied to Lunch with the same assumptions and Table 19 shows the results for a single day, Monday, 02 June, 1980 for EDF NAVSTA San Diego. Table 20 shows the combined computational results for the first week of June 1980 for both EDFs and is similar to Table 18 (Breakfast).

Table 17

Headcounts and food quantities (lb) for Breakfast at EDF NAVSTA San Diego (2 June 1980)

Food item	Headcount	Ingredients	
		Refrigerated (lb)	Dry (lb)
Rolls	340	26.06	43.11
Glaze (rolls)	340	6.92	19.22
Beverages, hot	720	0	43.11
Beverages, cold	720	122.19	116.44
Ham	340	93.94	60.97
Pork	340	93.94	60.97
Bacon	630	174.07	112.98
Eggs	720	149.84	45.17
Oatmeal	100	2.67	24.63
Cereal, ready to eat	620	0	152.71
Potatoes	480	200.46	62.10
Pastry	720	20.44	126.13
Totals: Meals produced:	720	890.53 lb	867.84 lb

Table 18

Headcounts and food quantity estimates (lb) for Breakfast by refrigerated and dry storage at EDF NAVSTA San Diego and EDF NAS North Island (first week of June 1980)

Day	EDF NAVSTA San Diego			EDF NAS North Island		
	Headcount	Refrigerated (lb)	Dry (lb)	Headcount	Refrigerated (lb)	Dry (lb)
Monday	720	890.53	867.84	770	990.72	1,012.76
Tuesday	840	1,316.56	1,099.60	770	990.72	1,012.76
Wednesday	840	1,300.14	1,085.99	770	990.72	1,012.76
Thursday	840	1,154.24	1,071.33	770	1,062.56	1,059.40
Friday	840	993.70	869.92	740	959.57	978.28
Saturday	720	1,266.39	981.35	550	676.73	712.71
Sunday	720	1,053.76	1,007.28	550	729.23	746.78
Totals (week)	5,520	7,975.32 lb	6,983.31 lb	4,920	6,400.25 lb	6,535.44 lb

Table 19

Headcounts and food quantities (lb or gal) for Lunch at EDF NAVSTA San Diego (2 June 1980)

Food Item	Headcount	Ingredients Refrigerated (lb)	Ingredients Dry (lb)	Stock (gal)
A. Normal menu				
Soup	550	50.17	103.27	28.38
Poultry	730	477.13	117.04	21.07
Stuffed Pepper	640	242.32	210.89	22.18
Gravy	550	37.74	84.50	8.88
Potatoes	650	271.45	84.10	–
Rice	650	44.13	172.92	16.25
Mixed Vegetables	550	114.05	108.05	–
Squash	550	150.44	38.81	–
Salad	960	210.90	154.00	–
Salad Dressing	960	42.10	89.40	–
Pastry	960	27.25	168.18	–
Sauces	960	42.50	78.85	–
Beverages, hot	960	0	57.48	–
Beverages, cold	960	162.92	155.25	–
Total	960	1,873.01 lb	1,622.74 lb	96.76 gal
B. Speedline				
Soup	340	31.01	63.84	17.55
Sandwiches:				
Hamburgs				
Cheeseburgers				
Franks				
Tacos				
Total combined	1,600	504.39	446.83	–
Potatoes	410	171.22	53.05	–
Salad	600	131.81	96.25	–
Salad Dressing	600	26.25	55.88	–
Desserts	600	102.43	230.29	–
Beverages, hot	600	0	35.92	–
Beverages, cold	600	101.82	97.03	–
Totals	600	1,068.93 lb	1,079.09 lb	17.55 gal
Total for Lunch	1,560	2,941.94 lb	2,701.83 lb	114.31 gal

Table 20

Headcounts and food quantity estimates (lb or gal) for Lunch by type of ingredient storage at EDF NAVSTA San Diego and EDF NAS North Island (first week of June 1980)

Day	Headcount	Ingredient		
		Refrigerated (lb)	Dry (lb)	Stock (gal)
EDF NAVSTA San Diego				
Monday	1,560	2,941.94	2,701.83	114.31
Tuesday	1,560	2,809.99	2,711.83	72.44
Wednesday	1,560	2,536.92	2,845.10	121.52
Thursday	1,560	2,771.62	2,692.23	86.77
Friday	1,560	2,965.26	2,826.51	92.13
Saturday	1,300	1,739.71	1,621.37	33.04
Sunday	1,300	1,677.01	1,507.69	61.68
Totals	10,400	17,442.45 lb	16,916.56 lb	581.89 gal
EDF NAS North Island				
Monday	1,250	2,420.69	2,470.49	61.03
Tuesday	1,560	3,357.06	3,036.20	106.89
Wednesday	1,730	2,999.67	2,952.46	66.89
Thursday	1,560	3,671.40	3,307.26	130.15
Friday	1,730	3,200.80	37.20.43	96.58
Saturday	1,300	1,732.93	2,460	29.80
Sunday	1,300	2,102.37	2,158.37	68.05
Totals	10,430	19,484.92 lb	20,105.56 lb	559.39 gal

The above procedure was repeated for the Dinner meal period. A speedline was available each day at Dinner. Table 21 shows the results for a single day, Monday, 02 June 1980 at EDF NAVSTA San Diego. Table 22 shows the combined computational results for the first week of June 1980 for both EDFs and is similar to Table 20 (Lunch).

C. Food Estimates/MIDRATS

The EDF NAS North Island also prepared MIDRATS in addition to the normal Breakfast, Lunch, and Dinner menus. Table 23 shows a typical assumed MIDRATS menu and the ingredient requirements following the procedure outlined above and Table 24 shows the daily requirements for a full week.

The above food quantities are only for one week in June 1980 and the menu changed on a 21- or 35-day cycle during the month. Similar spot computations were made for days that had different food items and there was no statistically significant difference in subsistence food ingredient requirements from one week to the next with the changing menus. Hence, computations for the remaining weeks are not shown and it is assumed that there is no significant change in food quantity requirements within the typical 21- and 35-day menu cycles. The major variable within the 21- and 35-day menu cycle is the number of meals prepared.

D. Food Quantities by Storage and Per Day

Table 25 is a composite of the total daily food ingredients by refrigerated and dry storage to provide the estimated production at each EDF. The results shown in this table will be correlated to the actual storage capacity at each EDF to determine the excess storage capacity at each unit with different food procurement cycles.

Table 25 provides the actual storage and material requirements to provide the mean number of headcounts per EDF. The material requirements were also adjusted by the standard deviation based on a 75 percent selection level of the particular food item and a 75 percent adjustment for the different types of food items within a food group. The quantities indicated in Table 25 would in reality represent average high estimates of food subsistence requirements. On some days there may be excess food produced, which could then be used as a special "left-over" food item on the next day. This addition was indicated on both menus, especially towards the end of the week. There are two potential effects of the use of "left-over" foods: one is to reduce the food quantity estimates for storage; second to reduce the labor required to produce the food. These possible effects are not included in the previous tables.

The results shown in this section are based on the actual weekly menu and Table 25 could be used to estimate total overall food ingredient quantities by refrigerated and dry storage. Table 26 indicates ingredient requirements per meal for the menu and food selection ratios existing during June 1980 at each EDF and including MIDRATS at the EDF NAS North Island.

One final set of data will be developed for menu food items (groups) by refrigerated or dry storage ingredients. These data can be used to estimate food ingredient storage requirements per food (group) serving. The data will be based on the food selection percentage

Table 21

Headcounts and food quantities (lb or gal) for Dinner at EDF NAVSTA San Diego by type of ingredient (2 June 1980)

Food Item	Headcount	Ingredient		
		Refrigerated (lb)	Dry (lb)	Stock (gal)
A. Normal menu				
Soup	460	41.96	86.37	23.74
Steak	540	234.47	91.36	8.10
Ham	530	177.38	172.79	–
Gravy	460	31.56	70.68	7.43
Sauce	380	26.07	58.39	6.13
Potatoes	540	225.52	69.87	–
Rice	540	36.66	143.66	13.50
Asparagus	460	96.60	10.80	–
Beets	180	1.80	59.15	–
Salad	800	175.75	128.33	–
Salad Dressing	800	35.00	74.50	–
Rolls	540	52.39	99.46	–
Pastry, dessert	800	22.71	140.15	–
Beverages, hot	800	0	47.90	–
Beverages, cold	800	135.77	129.38	–
Totals	800	1,290.64 lb	1,382.79 lb	58.90 gal
B. Speedline				
Soup	290	26.45	54.45	14.97
Hamburger	330	104.03	92.16	–
Cheeseburger	330	104.03	92.16	–
Franks	330	104.03	92.16	–
Barbeque Beef	330	104.03	92.16	–
Chips	–	–	–	–
Salad	500	109.84	80.21	–
Salad Dressing	500	21.88	46.50	–
Dessert	500	159.18	98.09	–
Beverages, hot	500	0	29.94	–
Beverages, cold	500	84.85	80.86	–
Totals	500	818.32 lb	758.75 lb	14.97 gal
Total for Dinner	1,270[a]	2,108.96 lb	2,141.54 lb	73.87 gal

[a]Estimated total mean headcount is 1,270 for a Monday, the 500 speedline production estimate includes its specific standard deviation.

Table 22

Headcounts and food quantity estimates (lb or gal) for Dinner by type of ingredient storage at EDF NAVSTA San Diego and EDF NAS North Island (first week of June 1980)

Day	Headcount	Ingredient Refrigerated (lb)	Dry (lb)	Stock (gal)
EDF NAVSTA San Diego:				
Monday	1,270	2,108.96	2,141.54	73.87
Tuesday	1,270	2,552.18	2,551.22	106.76
Wednesday	1,270	2,148.62	2,117.25	90.93
Thursday	1,270	2,257.00	2,065.59	100.36
Friday	1,130	1,977.71	1,898.23	88.39
Saturday	1,130	2,065.03	1,949.06	70.33
Sunday	1,270	2,225.35	2,213.87	100.36
Totals	8,610	15,334.85 lb	14,936.76 lb	631.00 gal
EDF NAS North Island:				
Monday	1,130	1,998.97	1,824.55	69.04
Tuesday	1,070	1,714.01	1,685.54	50.20
Wednesday	1,070	1,394.34	1,849.30	67.79
Thursday	1,070	1,837.13	1,661.15	51.32
Friday	1,130	2,079.81	1,984.91	58.60
Saturday	1,130	1,992.67	1,967.36	29.29
Sunday	1,130	2,077.38	1,923.03	56.71
Totals	7,730	13,094.31 lb	12,895.84 lb	382.95 gal

Table 23

Headcounts and food quantities (lb) for MIDRATS at EDF NAS North Island for a typical Monday in June 1980

Food Item	Headcount	Ingredient Refrigerated (lb)	Dry (lb)
Salad	550	120.80	88.30
Salad Dressing	550	24.07	51.21
Sandwiches	1,100	346.69	307.14
Beverages, cold	550	93.33	88.92
Dessert, cookies	550	15.05	67.19
Totals	550	599.94 lb	602.76 lb

Table 24

Headcounts and weekly food quantities (lb) for MIDRATS at EDF NAS North Island for a typical June 1980 week

Day	Headcount	Ingredient	
		Refrigerated (lb)	Dry (lb)
Monday	550	599.94	602.76
Tuesday	550	599.94	602.76
Wednesday	550	599.94	602.76
Thursday	550	599.94	602.76
Friday	550	599.94	602.76
Saturday	210	229.05	230.11
Sunday	210	229.05	230.11
Totals	3,170	3,457.80 lb	3,474.02 lb

Table 25

Headcounts and total daily food quantity (lb or gal) storage requirements at EDF NAVSTA San Diego and EDF NAS North Island based on estimated food production requirements for a week in June 1980

Day	Headcounts*	Ingredient		
		Refrigerated (lb)	Dry (lb)	Stock (gal)
EDF NAVSTA San Diego:				
Monday	2,978.12	5,941.43	5,711.21	188.18
Tuesday	3,170.03	6,678.73	6,362.65	179.20
Wednesday	3,170.03	5,985.68	6,048.34	212.45
Thursday	3,170.03	6,182.86	5,829.15	187.13
Friday	2,871.98	5,936.67	5,604.65	180.52
Saturday	2,099.98	5,071.13	4,551.78	103.37
Sunday	2,398.03	4,956.12	4,728.84	162.04
Totals	19,858.20	40,752.62 lb	38,836.62 lb	1,212.89 gal
EDF NAS North Island:				
Monday	3,111.16	6,010.32	5,910.56	130.07
Tuesday	3,443.61	6,661.73	6,337.27	157.09
Wednesday	3,558.02	5,984.67	6,417.28	134.68
Thursday	3,443.61	7,171.03	6,630.57	181.47
Friday	3,240.16	6,840.12	7,286.38	155.18
Saturday	2,072.70	4,631.38	5,370.53	59.09
Sunday	2,072.70	5,138.03	5,058.29	124.76
Totals	20,941.96	42,437.28 lb	43,010.88 lb	942.34 gal

*Mean headcounts for each weekday

Table 26

Estimated food ingredients (lb per meal) at EDF NAVSTA San Diego and EDF NAS North Island for June 1980

	Refrigerated	Dry
EDF NAVSTA San Diego	2.052	1.956
EDF NAS North Island	2.026	2.054
Average[a]	2.039	2.006

[a]Weighted average

Table 27

Headcounts and average food subsistence storage (lb) requirements for Breakfast meats for the first week of June 1980 at EDF NAVSTA San Diego

Breakfast Meat	Headcount	Ingredients Refrigerated (lb)	Dry (lb)
Ham	340	93.94	60.97
Pork	340	93.94	60.97
Bacon	630	174.07	112.98
Bacon	730	199.76	129.08
Bologna	550	150.51	97.25
Pork	390	106.72	68.96
Lunch Meat	550	150.51	97.25
Beef	330	90.30	58.35
Bacon	730	199.76	129.08
Corned Beef	550	90.30	58.35
Ham	400	109.46	70.73
Pork	400	109.46	70.73
Bacon	730	199.76	129.08
Pork	400	109.76	70.73
Beef	330	90.30	58.35
Ham	340	93.04	60.12
Pork	340	93.04	60.12
Lunch Meat	470	128.62	83.11
Beef	280	77.37	50.21
Bologna	470	128.62	83.11
Pork	340	93.04	60.12
Totals	9,640	2,581.98 lb	1,669.85 lb
Mean		0.2678	0.1732

ratio at the two EDFs. A sample computation will be shown and the complete results will be indicated. These data will then be used to estimate food storage requirements for the various menus and food selection ratios at each EDF and each unit's food storage capacity can be fairly accurately estimated from these data.

The initial procedure is to determine the mean food ingredient refrigerated and dry storage requirements for Breakfast meats at EDF NAVSTA San Diego. The computational results are shown for the first full week of June 1980 in Table 27. Table 28 represents a summary of each food group by meal period for both EDFs and the mean for both units.

The estimated food ingredient requirements by type of storage (refrigerated and dry) for the two EDFs are given in Table 29 for each meal period per serving. The average ingredient requirements assume the same selection ratio as determined for each facility. A 100 percent selection is assumed when the facility did not report selections for specific food items. Beverages are excluded from these data. Food selection data are taken from Table 2. (Note, the various selection ratios for different meat and vegetable items have been accounted for in Table 28).

E. Storage Capacity

Normal chiller and freezer design criteria assume each cubic foot of chiller storage (between 32° and 40°F) will provide for 30 pounds of food, whereas each cubic foot of freezer storage (0°F or lower) will provide for 45 pounds of food. Freezer and chiller capacities will be combined for analysis purposes because each unit has the option of purchasing food for each type of storage. Table 30 shows the present storage capacity at each dining facility. A weighted average in pounds per cubic foot will be used and is determined by comparing the actual net storage floor area of freezer to chiller capacity and by applying the appropriate weight ratio to these factors to determine an average pounds per cubic foot for refrigerated storage. The results of the procedure for both EDFs are indicated in Table 31.

Table 32 shows the total storage capacity for dry and refrigerated storage for each EDF. Refrigerated storage is indicated in Table 31. Dry storage capacity is based on a design factor of 18 pounds per cubic foot (typical dry storage design factors vary from 18 to 25 or more pounds per cubic foot, the lower factor was used in this analysis as it provides a comfortable design safety factor from the normal 22 or more pounds per cubic foot frequently used).

Table 33 compares the storage capacity (Table 32) to storage requirements (Table 25), food ingredient procurement cycles for EDF NAVSTA San Diego and EDF NAS North Island, and the excess storage capacity for different procurement cycles at each EDF in pounds and in excess weeks of capacity.

The excess storage capacity will be used in a following section to determine the potential number of preprocessed meals that could be stored at each EDF for future utilization at the EDF, or for satellite feeding and storage.

Table 28

Average food subsistence storage requirements (lb/serving) for various food menu groups for June 1980 at EDF NAVSTA San Diego and EDF NAS North Island

Food Group/Meal Period	EDF NAVSTA San Diego		EDF NAS North Island		Combined[a]	
	Refrigerated (lb)	Dry (lb)	Refrigerated (lb)	Dry (lb)	Refrigerated (lb)	Dry (lb)
Breakfast						
Eggs	0.2081	0.0627	0.2081	0.0627	0.2081	0.0627
Cereal, prepared	.0267	.2463	.0267	.2463	.0267	.2463
Potatoes	.4175	.1293	.4175	.1293	.4175	.1293
Meat	.2678	.1732	.2726	.1769	.2699	.1749
Pastry and other	.3183	.1961	.3183	.1961	.3183	.1961
Lunch						
Meat	0.5259	0.2082	0.4833	0.2251	0.5046	0.2166
Vegetables	.1864	.1977	.1768	.2295	.1810	.2156
Salad and Dressing	.2634	.2535	.2634	.2535	.2634	.2535
Bread	.0487	.1887	.0487	.1887	.0487	.1887
Sandwiches	.3152	.2797	.3152	.2797	.3152	.2797
Dressing/Noodles	.0806	.1887	.0806	.1887	.0806	.1887
Sauces/Gravy	.0686	.1536	.0686	.1536	.0686	.1536
Soup, meat stock	.0912	.1877	.0912	.1877	.0912	.1877
Potatoes	.4175	.1293	.4175	.1293	.4175	.1293
Rice	.0679	.2660	.0679	.2660	.0679	.2660
Desserts	.0865	.1334	.0865	.1334	.0865	.1334
Dinner						
Meat	0.4686	0.2348	0.5276	0.2198	0.4966	0.2277
Vegetables	.1920	.1760	.1588	.2104	.1762	.2686
Salad and Dressing	.2634	.2535	.2634	.2535	.2634	.2535
Bread	.0487	.2317	.0487	.2317	.0487	.2317
Dressing/Noodles	.0806	.1887	.0806	.1887	.0806	.1887
Sauces/Gravy	.0686	.1536	.0686	.1536	.0686	.1536
Soup, meat stock	.0912	.1877	.0912	.1877	.0912	.1877
Potatoes	.4175	.1293	.4175	.1293	.4175	.1293
Rice	.0679	.2660	.0679	.2660	.0679	.2660
Desserts, average	.0869	.1334	.0869	.1334	.0869	.1334

[a]Weighted average

Table 29

Selections (% from Table 2) and average food subsistence requirements (total lb/serving and lb/meal) by type of storage at EDF NAVSTA San Diego and EDF NAS North Island for a typical daily menu during June 1980

Meal Period and Food Group	EDF NAVSTA San Diego			EDF NAS North Island		
	Selection (%)	Refrigerated (lb)	Dry (lb)	Selection (%)	Refrigerated (lb)	Dry (lb)
Breakfast						
Eggs	100	0.2081	0.0627	100	0.2081	0.627
Meat, 3 items	181	.2678	.1732	139	.2726	.1769
Potatoes	67	.4175	.1293	87	.4175	.1293
Cereal, prepared	13	.0267	.2463	13	.0267	.2463
Pastry	100	.0865	.1334	100	.0865	.1334
Bread	47	.0487	.1887	47	.0487	.1887
Other items	39	.3183	.1961	39	.3183	.1961
Average per meal		1.2095 lb	0.7934 lb		1.1872 lb	0.7517 lb
Lunch						
Soup	56	0.0912	0.1877	32	0.0912	0.1877
Meat, 2 items	135	.5259	.2082	134	.4833	.2251
Gravy Sauce	51	.0686	.1536	61	.0686	.1536
Potatoes	67	.4175	.1293	87	.4175	.1293
Rice	67	.0679	.2660	75	.0679	.2660
Vegetables, 2 items	102	.1864	.1977	111	.1768	.2295
Dressing Noodles	56	.0806	.1887	56	.0806	.1887
Salad and Dressing	100	.2634	.2535	100	.2634	.2535
Rolls	47	.4787	.1887	47	.0487	.1887
Dessert	100	.0865	.1334	100	.0865	.1334
Average per meal		1.7293 lb	1.5123 lb		1,7470 lb	1.6034 lb

Table 29 (cont'd)

Meal period and food group	EDF NAVSTA San Diego Selection (%)	Refrigerated (lb)	Dry (lb)	EDF NAS North Island Selection (%)	Refrigerated (lb)	Dry (lb)
Lunch: Speedline						
Soup	56	0.0912	0.1877	32	0.0912	0.1877
Sandwiches, 3 items	196	.3152	.2792	196	.3152	.2792
Potatoes	67	.4175	.1293	87	.4175	.1293
Salad and Dressing	100	.2634	.2535	100	.2634	.2535
Dessert	100	.0865	.1334	100	.0865	.1334
Average per meal		1.2985 lb	1.1259 lb		1.3601 lb	1.1067 lb
Dinner						
Soup	56	0.0912	0.1877	32	0.0912	0.1877
Meat, 2 items	134	.4686	.2348	134	.5276	.2198
Gravy/Sauces	51	.0686	.1536	80	.0686	.1536
Potatoes	67	.4175	.1293	87	.4175	.1293
Rice	67	.0679	.2660	75	.0679	.2660
Vegetables, 2 items	105	.1920	.1760	108	.1588	.2104
Dressing and Noodles	75	.0806	.1887	75	.0806	.1887
Salad and Dressing	100	.2634	.2535	100	.2634	.2535
Rolls	67	.0487	.1887	67	.0487	.1887
Dessert	100	.0869	.1334	100	.0869	.1334
Average per meal		1.6842 lb	1.6026 lb		1.8201 lb	1.6716 lb
Dinner: Speedline						
Soup	56	0.0912	0.1887	32	0.0912	0.1887
Sandwiches, 3 or 4 items	229	.3152	.2792	229	.3152	.2792
Salad and Dressing	100	.2634	.2535	100	.2634	.2535
Dessert	100	.0869	.1334	100	.0869	.1334
Average per meal		1.1232 lb	1.1314 lb		1.1013 lb	1.0863 lb

Table 30

Food storage capactiy at EDF NAVSTA San Diego and EDF NAS North Island

Type of storage	Gross floor square feet	Rack, square feet of floor area	Capacity cubic feet
EDF NAVSTA San Diego:			
Dry	1,484	769.00	4,614.00[a]
Meat Chiller	310	186.00	930.00[b]
Meat Freezer	496	294.75	1,473.75[b]
Vegetable Chiller	464	220.50	1,102.50[b]
Vegetable Freezer	143	85.75	428.75[b]
Root Storage	182	110.25	551.25[b]
Dairy Chiller	268	112.00	560.00[b]
Totals:	Dry: 4,614 cubic feet Chiller and freezer: 5,046.25 cubic feet		
EDF NAS North Island:			
Dry	1,102.50	550.75	3,304.50[a]
Meat Chiller	250.00	138.00	690.00[b]
Meat Freezer	400.00	215.25	1,076.75[b]
Vegetable Chiller	350.00	134.75	673.75[b]
Vegetable Freezer	120.00	66.75	333.75[b]
Dairy Chiller	175.00	80.00	400.00[b]
Totals:	Dry: 3,304.50 cubic feet Chiller and freezer: 3,174.25 cubic feet		

[a]Each floor square foot of rack area is equivalent to 6 cubic feet of capacity.

[b]Each floor square foot of rack area is equivalent to 5 cubic feet of capacity.

Table 31

The determination of the average storage capacity (lb/cubic foot) for refrigerated storage at EDF NAVSTA San Diego and EDF NAS North Island

	Net Storage Floor Area		Freezer/ Refrigeration Ratio	Weighted Average Capacity (lb/cu ft)
	Chiller	Freezer		
EDF NAVSTA San Diego	628.75	380.50	0.377	35.66
EDF NAS North Island	352.75	282.00	0.444	36.66

Table 32

Total food storage capacity expressed in total pounds at
EDF NAVSTA San Diego and EDF NAS North Island

	Dry (lb)	Refrigerated (lb)
EDF NAVSTA San Diego	83,052	179,949
EDF NAS North Island	59,481	116,368

Table 33

Excess storage capacity (lb) based on different food procurement cycles at
EDF NAVSTA San Diego and EDF NAS North Island

Procurement Cycle	Refrigerated (lb) Total	Requirement	Excess	Weeks	Dry (lb) Total	Requirement	Excess	Weeks
Weekly:								
EDF NAVSTA San Diego	179,949	40,753	139,196	3.41	83,052	38,337	44,215	1.13
EDF NAS North Island	116,368	42,437	73,931	1.74	59,481	43,011	16,470	0.38
Three times per week:								
EDF NAVSTA San Diego	179,949	15,969	163,980	4.02	83,052	14,992	68,060	1.75
EDF NAS North Island	116,368	15,780	100,588	2.37	59,481	16,340	43,141	1.00

VIII. EQUIPMENT UTILIZATION

Estimates regarding the utilization of kitchen equipment at each EDF should be regarded as best guesses because the recipe cards from the Armed Forces Recipe Service frequently indicate two or possibly even three processing techniques for a particular menu item. Another factor regarding food processing is the cook, or cooks. Each one or group may have a personal preference for certain types of equipment. Another factor is the menu, which is usually designed to balance the equipment load so all menu items can be prepared and served within a period of time. The estimates in the following tables will be maximum values based on the menus and in some cases on the primary food processer. For example, a steam kettle will be used as a primary processing unit as well as a holding unit during the service period.

Table 34 represents a list of available primary processing equipment at each EDF. The equipment list was developed from blueprints of each EDF. The total available equipment list is larger than indicated in Table 34. The list shown in Table 34 represents the primary critical equipment needed for food production, excluding the service of food.

Table 35 represents best estimates of use of primary food processing kitchen equipment for both EDFs for the normal work shift. The normal work shift includes the three primary meals. Many speedline food items are prepared at the speedline service area, as well as most Breakfast food items. The normal workday for the utilization of equipment is assumed to be 0600 to 1800 hours (6 AM to 6 PM). A 100-percent utilization indicates 12 hours of equipment use; a 50-percent utilization indicates 6 hours of equipment use within the work shift.

The estimates indicated in Table 35 are generally maximum percentages. Some units, for example, the continuous deep fat fryer, are not used on all days. The estimates were established by reviewing the menus, recipe cards, and attempting to balance the equipment load requirements. Another example of this figure is the roll-through oven, which could have a 75-percent utilization, or a 9-hour use, which would be more than enough time to prepare two meat entree items for the Lunch and Dinner meal periods and also provide time to clean the oven after use. Most meat entree items would require a 3-hour processing time per meal period.

A quick review of Table 35 indicates that the equipment could be utilized another 25 to 50 percent during the normal work shift without causing any serious equipment shortage problems.

IX. EXCESS MEAL PRODUCTION

Any excess meal production at each EDF would be based on adding a second primary work shift. The second work shift would work five days and produce meals at the same productivity as the normal work shift. Each EDF will be analyzed separately and appropriate assumptions for each EDF will be indicated.

Preprocessed food from each EDF could be delivered to a satellite facility or, in the case of EDF NAS North Island, could be delivered to a carrier. Food could be shipped in bulk containers for plating and serving at remote locations on base.

Table 34

Primary food processing kitchen and bakery equipment list at EDF NAVSTA San Diego and EDF NAS North Island, excluding storage, service, scullery, and vegetable preparation equipment

EDF NAVSTA San Diego: Initial Design: 2,881 – 3,720 Personnel

Main Kitchen Primary Equipment:

- 2 Roll-through convection ovens
- 2 Meat slicers
- 1 Continuous fryer
- 1 Continuous broiler
- 1 Continuous steam cooker
- 5 80 gallon steam kettles
- 3 40 gallon steam kettles
- 1 Mixer

Bakery:

- 1 Dough mixer
- 1 Roll-through proofer
- 1 Roll-through convection oven
- 1 Mixer

EDF NAS North Island: Initial Design: 2,171 – 2,880 Personnel

Main Kitchen Primary Equipment:

- 1 Roll-through convection oven
- 1 Meat slicer
- 1 Continuous broiler
- 1 Continuous deep fat fryer
- 1 Continuous steam cooker
- 2 60 gallon steam kettles
- 3 80 gallon steam kettles
- 1 40 gallon steam kettle
- 5 Vegetable steam cookers

Bakery:

- 1 Dough mixer
- 1 Roll-through proofer
- 1 Roll-through convection oven
- 1 Mixer

Table 35

Estimated equipment utilization for the primary food processing kitchen and baking equipment shown in Table 34

	Utilization (%)[a]
EDF NAVSTA San Diego:	
Main Kitchen Primary Equipment	
Roll-through convection ovens (2)	50 or less
Meat slicers (2)	50 or less
Continuous broiler	20 or less
Continuous deep fat fryer	10 or less
Continuous steam cooker	50 or less
80-gallon steam kettles (5)	40 or less
40-gallon steam kettles (3)	50 or less
Mixer	30 or less
Bakery	
Dough mixer	30 or less
Roll-through proofer	25 or less
Roll-through oven	50 or less
Mixer	50 or less
EDF NAS North Island:	
Main Kitchen Primary Equipment	
Roll-through convection oven	75 or less
Meat slicer	75 or less
Continuous broiler	50 or less
Continuous deep fat fryer	20 or less
Continuous steam cooker	30 or less
60-gallon steam kettles (2)	60 or less
80-gallon steam kettles (3)	50 or less
40-gallon steam kettle	40 or less
Vegetable steam cookers (5)	50 or less
Bakery	
Dough mixer	40 or less
Roll-through proofer	30 or less
Roll-through oven	60 or less
Mixer	50 or less

[a]Percent utilization is the estimated percentage of hours of equipment use to a potential use of 12 hours (0600 to 1800 hours).

Table 36 indicates the typical feeding requirements for an in-port carrier by meal periods for various periods of time and will be used for the partial analysis of EDF NAS North Island.

A. EDF NAVSTA San Diego

The basic design of EDF NAVSTA San Diego was to provide rations for 2,881 to 3,720 personnel per day, or an average of 3,300 persons per day. If each person consumed three meals per day, the design output of the facility was 9,900 meals per day. Table 7 indicates the estimated meals per meal period and will be used to establish a preliminary initial facility design excess meal production base. Table 37 shows the comparative outputs based on Table 7 and the design output of the facility for a five-day schedule (Monday through Friday).

Table 37 indicates that the EDF is currently producing 15,365 meals for the five-day period, or about 1,025 rations per day. An additional 2,275 rations per day could be prepared, or 34,125 meals during the five-day period.

1. **Productivity Increase.** An alternative productivity figure will be developed. In this case, an additional, similar-size work crew will be added as a second shift. Meal productivity figures will be used from Table 15 to determine the total meal output by work activity area. The minimum total meal output for a work activity area will indicate the maximum meal output of the second shift. These results are shown in Table 38. A second work force of 32-employees could produce 19,858 meals.

Equipment utilization would not be a factor with a second full or partial work shift. If the meals were to be prepared during the normal 0600 to 1800 work time, some equipment scheduling problems may develop and food would have to be prepared well in advance and stored for future use.

2. **Storage: Dry and Refrigerated.** The final, potentially limiting factor at EDF NAVSTA San Diego is the current storage capacity at the EDF. The first assumption that will be made is that food would be prepared during a five-day week and delivered to satellite service centers on seven-day cycle. (Satellite storage capacity will be used only for the day of use.) The maximum food preparation storage cycle would be for the weekend: Saturday, Sunday, and Monday. Food storage requirements are shown in Table 39. Table 39 is based on an output of 19,858 meals (Table 38), a satellite menu similar to the EDF, and a similar Breakfast, Lunch, and Dinner eating patterns (Table 37): 15,365 total meals of which 23.71% are Breakfast, 43.28% are Lunch, and 33.01% are Dinner). The total meal output of the 32-person second work shift of 19,858 meals would result in approximately: 4,708 Breakfasts, 8,595 Lunches, and 6,555 Dinners. Also, Table 39 indicates no storage problems as the EDF operates on three-food procurement cycles per week.

Table 39 suggests the refrigerated food ingredients will remain as refrigerated food storage items for future food consumption and dry food ingredients would be stored in dry storage. In all probability the dry ingredients when used for the preparation of food would have to be stored as refrigerated processed food. This will require nearly all the dry storage to become refrigerated storage as the refrigerated storage would increase from 18,963 pounds to 32,858 pounds, which has minimal effects on the excess refrigerated storage capacity.

Table 36

Feeding requirements by meals and meal periods for an in-port carrier for various in-port time periods

Meal period	Weekday	Weekend	Week	One Month	Three Months
Breakfast	500	275	3,050	13,217	39,650
Lunch	975	450	5,775	25,025	75,075
Dinner	600	450	3,900	16,900	50,700
MIDRATS	300	225	1,950	8,450	25,350
Totals	2,375	1,400	14,675	63,592	190,775

Table 37

Comparison of EDF NAVSTA San Diego design criteria and the actual food production and Breakfast, Lunch, and Dinner consumption for five days (Actual food consumption and production data is taken from Table 7)

	Breakfast			Lunch			Dinner		
Weekday	Actual	Design	Excess	Actual	Design	Excess	Actual	Design	Excess
Monday	576	3,300	2,724	1,330	3,300	1,970	1,073	3,300	2,227
Tuesday	768	3,330	2,532	1,330	3,300	1,970	1,073	3,300	2,227
Wednesday	768	3,300	2,532	1,330	3,300	1,970	1,073	3,300	2,227
Thursday	768	3,300	2,532	1,330	3,300	1,970	1,073	3,300	2,227
Friday	768	3,300	2,532	1,330	3,300	1,970	775	3,300	2,525
Totals	3,648	16,500	12,852	6,650	16,500	9,850	5,067	16,500	11,433

Table 38

Meal output of a second work shift at EDF NAVSTA San Diego

Work Activity Area	Work Force	Current Productivity Meals/ Manhour	Meals/Worker/ Week	Meal Output/ Workweek
Bake shop	5	84.50	3,971.64	19,858
Butcher shop	2	264.78	9,929.10	19,858
Galley	19	20.58	1,045.17	19,858
Stores	3	165.48	6,619.40	19,858
Records	3	116.81	6,619.40	19,858
Totals	32	10.39 Meals	620.57 Meals	19,858 Meals

Table 39

Storage requirements (lb) for the meal production capacity of a second 32-person work shift at EDF NAVSTA San Diego for a three-day procurement cycle at the facility

Meal period	Meals three days	Storage Refrigerated (lb)	Dry (lb)
Breakfast	2,825	3,417	2,242
Lunch	5,157	8,920	7,800
Dinner	3,933	6,626	3,843
Totals	11,915	18,963	13,895
Excess Storage Capacity:		163,980	68,060

3. **Storage: Freezer.** One final factor remains, if the satellite processed food must be frozen the freezer capacity of the EDF could become a critical factor. Table 30 indicates that the total freezer capacity of the EDF was 1,902.50 cubic feet, or 85,612.50 pounds (at 45 pounds per cubic foot). The freezer requirements for the normal operation at the EDF are estimated at 7,600 pounds based on three procurement cycles per week, leaving an excess of about 78,000 pounds. It must be assumed that not all food ingredients will be available for consumption, there are cooking losses and trimming wastes. These losses will account for at least 25 percent, leaving a food yield of 75 percent of the above 32,858 pounds, or 24,644 pounds of net food storage requirements.

The difference between 78,000 and 24,644 pounds appears to be more than adequate to freeze processed foods. However, this large difference can be misleading. Actually, 8,315 pounds of food may be refrigerated each day from normal room temperature. During the five work days of the second shift, it is assumed that the daily satellite requirements will be met and storage requirements are minimal as warm or refrigerated food can be trucked in bulk containers for plating and serving. Enough additional food must be prepared during the five-day work week to service the satellite facility for the two nonworking days. This requirement was estimated at about 8,315 pounds per day. The reasonable question that must be answered is, does the present refrigeration capacity of the EDF have enough capability to remove the product load from this amount of food?

The potential product load is estimated at about 190,000 Btu per day for chiller storage (40°F) or 1,400,000 Btu per day for freezer storage (0°F), or 1,500,000 Btu per day for a blast freezer (–30°F). If the current freezer assumed a minimal product load (because frozen food would be procured) the compressor-condenser freezer unit would not have the capacity for the above product loads.

A blast freezer (–30°F) would have a product load, excluding normal transmission, infiltration, and appliance heat loads, of 1,500,000 Btu per day (93,750 Btu per hour, based on a 16-hour daily base). After the preprocessed food items are frozen, they could be moved to the current freezer for future use. The blast freezer would be the only additional equipment required for the EDF.

B. EDF NAS North Island

The base design of EDF NAS North Island was to provide rations for 2,171 to 2,880 personnel, or an average of 2,525 per day. If each person consumed three meals per day, the design output of the EDF is 7,575 meals per day. Table 6 indicates the estimated meals per meal period and will be used to establish a preliminary initial facility design excess meal production base. Table 40 shows the comparative outputs based on Table 6 and the design output of the EDF for a five-day schedule (Monday through Friday).

As an example of the excess output, the initial facility design of the unit indicates that the weekly in-port carrier meals could be prepared including MIDRATS within a five-day period. Meals could be prepared in advance during the week for weekend service on the carrier. This would represent the only storage requirement, as weekday meals could be delivered the same, or during the next day to the carrier.

Table 40

Comparison of EDF NAS North Island design criteria and actual food production and meal consumption for five-weekdays (actual food consumption and production data are taken from Table 6)

Weekday	Breakfast			Lunch*			Dinner		
	Actual	Design	Excess	Actual	Design	Excess	Actual	Design	Excess
Monday	728	2,525	1,797	1,609	2,525	916	775	2,525	1,750
Tuesday	728	2,525	1,797	1,724	2,525	801	992	2,525	1,533
Wednesday	728	2,525	1,797	1,838	2,525	686	992	2,525	1,533
Thursday	728	2,525	1,797	1,724	2,525	801	992	2,525	1,533
Friday	627	2,525	1,898	1,839	2,525	686	775	2,525	1,750
Totals	3,539	12,625	9,086	8,735	12,625	3,890	4,526	12,625	8,099

*Lunch includes MIDRATS

Table 41

Estimated personnel requirements to produce 14,675 weekly meals for an inport carrier at EDF NAS North Island

Work Activity Area	Productivity		Personnel required for 14,675 meals	
	Meals/Worker/ Week	Meals/ Manhour	Actual	Rounded
Bake shop	2,094.20	38.08	7.01	7
Butcher shop	10,470.98	261.77	1.40	2
Flight galley	739.58	44.56	3.45	4
Galley	722.14	11.41	20.32	20
Stores	3,490.33	66.48	4.20	4
Records	1,745.16	43.63	8.41	9
Totals	283.00	5.16	44.79	46

1. **Productivity Increase.** A second work force personnel shift can be added to the facility with an assumed productivity equivalent to existing facility's to produce the weekly requirement of 14,675 meals for an in-port carrier. The size of the personnel work force can be estimated. Table 15 indicates the productivity of the unit and the second work shift size by work activity area is shown in Table 41.

An alternate productivity figure will also be developed. In this case, a new, full-size work crew will be added as a second work shift. Meal productivity figures will be used from Table 15 to determine the total meal output by work activity area. The minimum total meal output for a work activity area will indicate the maximum meal output of the second work shift. These results are shown in Table 42.

A work force of 62 employees could produce 20,942 meals (Breakfast, Lunch, and Dinner) and 2219 MIDRATS. The difference in meal outputs between Tables 41 and 42 represents the excess output of the 16 additional workers. In theory, a three-month in-port carrier food requirement could be produced in about nine weeks with a second full work shift plus one flight galley person at this EDF. Out of a total of 13 weeks (three months), a nine-week period would provide a safety factor of about four weeks for personnel leaves, training, illness, and personal time. It is also apparent that the EDF could provide a total of 20,942 meals per week for one or more satellite service facilities.

Equipment utilization would not be a factor with a second full or second partial work shift. It would be difficult to produce the excess meals during the normal 0600 to 1800 hour work time as current equipment utilization may reach 75 percent for the current normal production during this time period. If the example in-port carrier meals were to be produced during this time period, one additional roll-through convection oven and a second meat slicer would be the minimum additional equipment requirements. If the second full work shift worked on a different work schedule, say 1800 to 0600 hours, no additional food production equipment would be necessary at this EDF.

2. **Storage: Dry and Refrigerated.** The final potential limiting factor at EDF NAS North Island is the current storage area at the EDF. The first assumption that will be made is the carrier's in-port food would be prepared during a five-day week and delivered to the carrier on a seven-day cycle (carrier storage capacity will only be used for the day of use). The maximum storage cycle would be for the weekend: Saturday, Sunday, and Monday. Table 43 indicates subsistence storage requirements for the carrier and indicates the excess storage capacity at the EDF (Table 33). Food ingredient requirements were given in Table 39 for Breakfast, Lunch, and Dinner, and Table 23 for MIDRATS. Table 36 was used to determine the meal requirements for the maximum three-day meal period for the example in-port carrier. Table 43 indicates no food storage problems if the EDF operates with three food procurements per week.

Table 44 indicates the number of weeks of in-port carrier storage available at the EDF. It appears from Table 44 that the dry storage capacity is the limiting storage factor, a 2.13-week potential capacity. If the food production personnel produced food for nine weeks of the maximum carrier in-port period of 13 weeks, not enough dry storage is available for the four non-food-producing weeks. This apparently limiting factor will be clarified in the following paragraphs.

Table 42

Meal output of a second full work shift at EDF NAS North Island

Work Activity Area	Work Force	Items Meal/ Week/Worker	Items Meal/ Manhour	Meals/Week
Bake shop	10	2,094.20	38.08	20,942
Butcher shop	2	10,470.98	261.77	20,942
Flight galley	3	739.58	44.56	2,219
Galley	29	722.14	11.41	20,942
Stores	6	3,490.33	66.48	20,942
Records	12	1,745.16	43.63	20,942
Totals: Meals	62	283.00	5.16	20,942

Table 43

Comparison of a typical in-port carrier's meal and corresponding food storage requirements to actual excess storage capacity for a three-day procurement cycle at EDF NAS North Island

Meal Period	Meals (3 Days)	Storage Refrigerated (lb)	Storage Dry (lb)
Breakfast	1,040	1,247	790
Lunch	1,875	3,276	3,007
Dinner	1,500	2,730	2,508
MIDRATS	750	818	822
Totals		8,071 lb	7,127 lb
Excess Storage Capacity:		100,588 lb	43,141 lb

NOTE: The menu served on the in-port carrier is similar to the normal menu at the EDF.

Table 44 suggests the refrigerated food ingredients will remain as refrigerated food storage menu items for future consumption and dry food ingredients would be stored in dry storage. In all probability the dry ingredients, when used for the preparation of food, would have to be stored as refrigerated processed food. This would require all the dry storage to become refrigerated storage and the refrigerated storage would increase from 22,936 to 43,146 pounds. The initial result is to reduce the potential number of weeks of carrier storage from 4.39 to 2.33 weeks, well below the four weeks indicated above.

The total production of a second work shift, shown in Table 42, could be utilized at remote or satellite foodservice areas. If the meal eating patterns at the remote or satellite service facility are similar to EDF NAS North Island eating patterns, Table 40, the food storage requirements are indicated in Table 45.

Following the reasoning established above and in previous sections, preprocessed meals would probably be refrigerated for future use, especially for weekend satellite service. This preprocessing would indicate that all the food ingredients removed from dry storage would become refrigerated items and increase the refrigeration load from 19,977 to 37,642 pounds, again far below the excess storage capacity of the EDF.

The remainder of this section will consider only the maximum output of a second work shift of 62 personnel and a weekly production for satellite food distribution of 20,942 meals, which is in excess of an in-port carrier.

3. Storage: Freezer. One final factor remains. If the processed food must be frozen, the freezer capacity of the unit becomes critical. Table 30 indicates that the total freezer capacity of the unit was 1,410.50 cubic feet, or 63,472.50 pounds, at 45 pounds per cubic foot. The freezer requirement for the normal operation of the EDF is estimated at about 8,600 pounds based on three procurement cycles per week, leaving an excess of about 54,000 pounds. It must be assumed that not all food ingredients will be available for consumption, there are cooking losses and trimming wastes. These losses will account for at least 25 percent, leaving a food yield of 75 percent of the above 36,642 pounds or 28,232 pounds of net food storage.

The difference between 63,472 and a normal freezer requirement of 8,600 pounds appears to be adequate to freeze the 28,232 pounds of processed food. Actually, 9,411 pounds of food may be refrigerated each day from normal room temperature. During the five work days of the second work shift, it is assumed that the daily satellite requirements will be met and daily storage requirements are minimal as warm or refrigerated food could be trucked in bulk containers for plating and serving. Enough additional food must be prepared during the five day work week to service the satellite facilities for the two nonworking days. This requirement was estimated at about 9,411 pounds per day. Again, a reasonable question that must be answered is, is the present refrigeration capacity of the EDF large enough to remove the product load from this amount of food?

The potential product load can be estimated at about 212,000 Btu per day for chiller storage (40°F), or 1,560,000 Btu per day for freezer storage (0°F), or 1,700,000 Btu per

Table 44

Comparison of a typical in-port carrier's meal requirements and corresponding food storage requirements to actual excess storage capacity for three food procurement cycles per week at EDF NAS North Island

Meal Period	Meals/Week	Storage Refrigerated (lb)	Storage Dry (lb)
Breakfast	3,050	3,621	2,293
Lunch	5,775	10,089	9,260
Dinner	3,900	7,099	6,520
MIDRATS	1,950	2,127	2,137
Totals	14,675	22,936	20,210
Excess Storage Capacity:		100,588	43,141
Weeks of Carrier Storage:		4.39	2.13

NOTE: The menu served on the example in-port carrier would be similar to the normal menu served at the EDF.

Table 45

Storage (lb) requirements for the meal production capacity of a second 62-person work shift at EDF NAS North Island for a three-day procurement cycle at the EDF

Meal Period	Meals (3 Days)	Storage Refrigerated (lb)	Storage Dry (lb)
Breakfast	2,367	2,811	1,780
Lunch	5,840	10,203	9,365
Dinner	3,027	5,511	5,061
MIDRATS	1,331	1,452	1,459
Totals	12,565	19,977 lb	17,665 lb
Excess Storage Capacity:		100,588 lb	43,141 lb
Percentage of Excess Capacity:		19.86%	40.95%

day for a blast freezer (−30°F). If the current freezer design assumed a minimal product load (because frozen food would be procured), the compressor-condenser freezer unit would not have the capacity for the above product loads.

The blast freezer (−30°F) would have a product load, excluding normal transmission, infiltration, and appliance heat loads, of 1,700,000 Btu per day (106,250 Btu per hour, based on a 16-hour design day). After the food products are frozen, they would be moved to the current freezer for future satellite use. The blast freezer would be the only additional storage equipment required at the EDF.

X. RESULTS, CONCLUSIONS, AND RECOMMENDATIONS

A. Food Production

The initial conclusion concerns the present capabilities of both EDFs to produce additional rations with their existing personnel assignments, kitchen processing equipment, service facilities, and subsistence storage capacity. Unless additional personnel are assigned to one or both EDFs, additional rations could not be produced. On certain days of the week a small number of additional rations could be produced but the volume of rations would not effectively support a remote on-base food service facility. It was determined that the menu varied with the day of the week and that the more time-consuming menu entree servings were produced on low headcount days, while the same personnel prepared less labor-intensive menu entree servings on high headcount days, resulting in higher daily productivities (meals per manhour). The initial conclusion is that the present personnel could not produce sufficient rations for remote on-base feeding facilities. However, it may be possible to increase the meal output of each EDF by increasing the headcount at each unit (transporting people to the EDF to be fed). This transporting would present very minor problems. The maximum daily meal output at EDF NAS North Island is 3,559 per meal period and 3,171 at EDF NAVSTA San Diego.

B. Selection Ratios

Several factors were analyzed and may have value beyond the scope of the intended analysis of this report. The selection ratios of menu items were analyzed in some detail and were used to estimate food production requirements and subsistence storage requirements. These same selection ratios were assumed to be reasonably correct for remote foodservice facilities with similar menus to the analyzed EDFs.

A linear model was developed to project the number of full servings of food items that would be selected from a number of food offerings available on a menu. The model correlated to the actual selection ratios for Breakfast and the combination of Lunch and Dinner. While the model does not indicate which of the available food items would actually be selected, it does indicate the total number of full servings. It was found that as the number of available food items increases, the total number of food items selected increases in a linear ratio. This fact means that a menu with a large number of available food items would have a higher overall selection of total food items than a menu with relatively few available food items.

C. Productivity: Military vs. Civilian

It was also determined that worker productivity appears to be a function of military or civilian personnel assignments in specific work areas. The EDF NAVSTA San Diego utilized supplemental civilian personnel in the galley and for the DHMAA force and their productivity was much higher than the all-military counterparts at EDF NAS North Island. If an equivalent number and ratio of civilian personnel were used at EDF NAS North Island the EDF probably would be able to produce additional rations to support a remote foodservice facility. Actually, another 12,450 meals could be produced per week. The cost-effectiveness of this conclusion was not investigated in this report.

D. Productivity: Meals per Manhour

The EDF NAS North Island had increased headcounts during a portion of June 1980 because the facility was partially feeding an in-port carrier. Personnel were bussed or walked from the in-port carrier to the EDF for their meals. Additional kitchen personnel were also assigned to the EDF to handle the excess headcount, a normal procedure. While the excess headcounts did not exceed the design feeding capacity of the EDF, the productivity of kitchen personnel decreased in many areas, specifically, bake shop, DHMAA force, and galley, with higher headcounts. The productivity decrease represented the bulk of the additional assigned foodservice personnel. Some kitchen area productivities increased, namely, the butcher shop, flight galley, speedline, stores, and records. However, the galley is the critical work area and its production and capacity control the output of the entire kitchen. The general conclusion is that while total facility meal output can be increased with additional personnel on the same work shift, primarily 0600 to 1800 hours, the productivity, expressed in meals per manhour, is reduced. This finding is also normal in commercial foodservice operations: there are just too many people in a limited space, all attempting to utilize the same equipment.

E. Specific EDFs

Additional results and conclusions will apply to each specific EDF.

1. **EDF NAVSTA San Diego.** This facility is larger than EDF NAS North Island and was initially designed to feed from 2,881 to 3,720 personnel per day. The design base is well above the current meal output of the EDF. The current maximum output of the EDF is about 1,100 full rations per day (midweek). If the initial design figures are correct, at least another 2,000 rations per day could be prepared at the EDF if adequate personnel are provided and if the present meal service hours are extended by about two hours per meal period.

In order to accomplish this additional meal load, another 93 workers would have to be added to the kitchen and service work force in the same work area personnel distribution as the existing force and with the same ratio of civilian to military personnel. Food would have to be procured at least three times per week so that the subsistence storage areas would not be overloaded. Employees would have to be scheduled in full work shifts around the clock, seven days per week. Some food would have to be prepared in the evening for next

day consumption. Equipment utilization would reach 100 percent for almost 20 hours of the day. This situation would represent the maximum weekly output and would probably cause numerous transition problems for personnel and especially production and equipment scheduling. This level of expectation or production is not recommended at the present time, but could eventually be obtained if the daily output of the EDF is gradually increased and planning and scheduling problems solved over a period of time.

It is recommended that a second work shift, equivalent in size to the normal work shift, be added to the EDF during the evening–night hours, 1800 to 0600 hours. Food could be prepared for use the next day or placed into storage for future consumption. The second work shift would consist of the following additional personnel: bake shop, 5; butcher shop, 2; galley, 19; stores, 3; records, 3, or a total of 32 persons. The weekly meal output would be approximately 20,000 meals based on five full work days per week. Present kitchen equipment would be adequate and current storage capacity is more than adequate based on three food procurements per week. A blast freezer (–30°F) would be necessary and recommended as food would be prepared for future consumption. The blast freezer would have a daily product load of 1,500,000 Btu, or a 93,750 Btu per hour product load, excluding transmission, infiltration, and appliance loads. The frozen food could then be removed from the blast freezer and moved to the normal freezer storage areas of the EDF. The same food could be trucked to remote feeding areas for reconstitution or, if required in emergency situations, be utilized by the present EDF. It would also be possible for the regular day crew to produce also food for remote area use and for the second work shift to produce EDF food. The two work crews should not be treated as separate work crews, one crew for normal EDF production and the second work crew for remote units. Production assignments could be interchanged between the work crews. Equipment utilization and personnel scheduling could be maximized in these cases.

2. **EDF NAS North Island.** This facility was initially designed to feed from 2,171 to 2,880 persons per day (full rations). It is smaller than EDF NAVSTA San Diego and has a lower employee productivity ratio. These facts will cause some problems if the meal output of the EDF is greatly increased. This EDF was analyzed from two viewpoints: one, could it produce the meal requirements of an in-port carrier for an extended period of time? Second, what additional capacity could be expected from the EDF if it was to service remote-satellite foodservice areas?

EDF NAS North Island is currently providing a maximum daily meal output of about 3,560, or almost 1,200 full rations per day (midweek). If the initial design figures are correct, at least another 1,300 rations per day could be prepared at the EDF if adequate personnel are provided and if the present meal service hours are extended by about two hours per meal period. The present staff would have to be increased by at least 97 employees, meaning a high percentage of the crew would have to work during the hours of 1800 to 0600 (night) preparing food for consumption the next day. Food would have to be procured at least three times per week so that current subsistence storage areas would not be overloaded. Employees would be scheduled in a full work shift, seven days per week. Equipment utilization could become a problem if cooking is not done between 1800 and 0600 hours. If additional workers are scheduled during the normal work shift of 0600 to 1800 hours, two additional pieces

of kitchen equipment would be required — a roll-through convection oven, equivalent to the capacity of the present oven, and a second meat slicer, with the same capacity as the present unit. This heavy work schedule of employees between 0600 to 1800 hours would cause a crowded work environment and is not recommended. It is recommended that a second work shift be added during 1800 and 0600 hours, which would not require any additional kitchen equipment.

If the EDF is to prepare meals for remote foodservice area, including an in-port carrier, a second work shift is recommended. The second work shift would work five full days during the week. It would consist of 62 workers: bake shop, 10; butcher shop, 2; flight galley, 3; galley, 29; stores, 6; and records, 12 workers. The meal output for the five work days would be almost 21,000 meals. If food is procured at least three times per week, current subsistence storage is adequate. The 21,000 weekly meal output is in excess of the weekly meal requirement of an inport carrier, which is 14,675 meals. A blast freezer (−30°F) would be necessary and recommended as food would be prepared for future consumption. The blast freezer would have a daily product load of 1,700,000 Btu, or a 106,250 Btu per hour product load, excluding the transmission, infiltration, and appliance heat loads. The frozen food could then be removed from the blast freezer and moved to the normal freezer storage areas of the EDF. The same food could then be trucked to remote feeding area for reconstitution, or, if required in emergency situations, be utilized by the present EDF. It would also be possible for the regular day crew to prepare food for remote area use and for the second shift to produce EDF food. The two crews should not be treated as separate work crews, one crew for normal EDF production and the second crew for remote facilities. Equipment utilization and personnel scheduling could be maximized in this case.

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